Instruction Manual

EXA TB

Model TB450G-H
NTU-compliant Surface Scattered Type Turbidity Meter [High Range Type]

IM 12E04A03-02E

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YOKOGAWA
Yokogawa Electric Corporation

IM 12E04A03-02E
1st Edition

Introduction

This instruction manual describes on the specifications, principle of measurement, and maintenance for Model TB450G-H High-range type NTU-compliant Surface Scattered Type Turbidity Meter.

For the Model TB450G-H high-range type, refer to other instruction manual "IM 12E04A03-01E".

Notation

Symbol Marks

In this manual, the following symbols are used to represent the following contents.

Warning ..... Description of precautions to take against dangers such as electric shock that can cause fatal or serious injury to the operator.

Important ..... Description of precautions to take against damaging software or hardware that could cause a failure in the system.

Note ..... Description of items to be noted in order to understand the operation and features of the equipment.

Tip ..... Additional information.

Reference ..... An item or a page to be referred to.

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NOTATION

Notice about this manual book

- Pass this book to the final user.
- Read this book thoroughly to understand the contents before operating the equipment.
- This book is to describe the functions of the product in detail, and not to warrant that the product match to each customer's requirement.
- Do not reprint or duplicate any part or all of this book without YOKOGAWA's permission.
- The content of this book may be altered without notification.
- We made our best effort to complete this book, however, if you find any questionable matters, error, or insufficient description, please contact our agent nearby, or our sales division.

Notice about protection, safety, and changing of our product

- For protection and safety of the product and the system controled with the product, operate the product in compliance with the safety instructions in this book.
- Any protection or safety circuit adapted to the product or the system controled with the product must be installed separately outside of our product. Do not make any modification of the product to install them inside the product.

Exemption from responsibility with the product

- We do not warrant our product except as provided in the warranty clauses.
- We do not have any responsibility for direct or indirect damages of the customer or any third party caused by using our product or unexpected fault of our product

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Revision Record

1. OVERVIEW

The range of applications for turbidity meters, originally used only for operation and management of water purification plants, has recently been expanded to include such applications as turbidity detection in chemical processes and measurements of concentration of suspended solids in a variety of industrial wastewater.

The TB450G NTU-compliant surface scattering type turbidity meter is an industrial turbidity meter employing the Right-angled Surface Scattering-light measuring method and has the following features:

- Incorporates a microprocessor, offering advanced performance and high reliability
- Enhanced self-diagnostics functions including lamp burn-out detection, converter check, and upper and lower limit alarm detection
- Variable output ranges from 10 NTU to 2000 NTU
- Use of the Right-angled Surface Scattering-light measuring method means that the optical system is free from contamination due to the suspension in the measured water
- Features a signal smoothing function and countermeasures against bubbles to reduce the effect from bubbles
- Extensive functions (automatic cleaning, automatic zero calibration, and more) available with optional pinch and solenoid-operated valves added to the sampling system

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Figure 1.1 TB450G NTU-compliant Surface Scattering Type Turbidity Meter

1.1 System Configuration

An NTU-compliant Surface Scattering type turbidity measuring system is usually composed of a detector, a converter, and a sampling system that feeds the measured water, zero calibration water, and cleaning water. The TB450G is offered not as a system but as components, a detector and converter, and can be combined with a desired sampling system to configure a turbidity measuring system. The inclusion of a pinch valve and solenoid-operated valve in the sampling system provides automatic cleaning and automatic zero calibration functions.

The following outlines typical system configurations employing a TB450G. For details of the detector and converter, see Section 1.2.

1.1.1 Configuration with Only TB450G Converter and Detector

A system comprising only a converter and detector is the simplest possible system, however, the following must be observed to ensure that there is no loss in the performance of the TB450G:

- The flow rate of the measured water needs to be 1.5 to 2.0 L/min at the detector. Provide a head tank to satisfy this condition as well as to deaerate the measured water.
- When measuring low turbidities not greater than 200 NTU, provide the specified micro filters on the feed line of zero calibration water.

1.1.2 Configuration with Sampling System

This system is composed of a converter, a detector, and a sampling system that feeds the measured water, zero calibration water, and cleaning water manually. This system requires the user to manipulate hand-operated valves to feed the measured water, perform cleaning, and perform a zero calibration. A diagram showing the recommended piping is shown in Section 2.8.1.

The measured water is introduced to the head tank (deaeration tank) via hand-operated valve V1. The measured water deaerated in the tank is fed to the measuring cell of the detector at a constant flow rate of 1.5 to 2.0 L/min due to the difference in the water head between the head tank and detector's measuring cell. The overflow is discharged through a drain hole.

Tap water filtrated by micro filters is used as the zero calibration water. Tap water is introduced to the micro filters via the hand-operated valve V2. The filtrated water is then fed to the detector's measuring cell at a constant flow rate via the hand-operated valve V3 and the head tank, and then discharged through the drain outlet.

Untreated tap water is used as the cleaning water. Tap water is fed from the side of the detector's measuring cell via the hand-operated valve V4, and a spinning flow is generated inside the cell to wash off the suspension on the cell wall. After cleaning, the user should open the hand-operated valve V5 situated below the head tank, to drain the suspension of the measuring cell and head tank together with the measured water at the same time.

1.1.3 Configuration with Sampling System and Automatic Cleaning System

This system is configured by assembling an automatic cleaning system to the configuration described in Section 1.1.2 immediately above. The recommended piping is shown in the diagram in Section 2.8.2.

For automatic cleaning, the solenoid-operated valve SV2 is installed in the cleaning water pipe as a cleaning water valve, and the pinch valve SV1 below the head tank as a drain valve. Both SV1 and SV2 can be controlled by the automatic cleaning sequence set in the converter to clean the detector and head tank automatically.

1.1.4 Configuration with Sampling System, Automatic Cleaning System, and Automatic Zero Calibration System

This system is configured by assembling an automatic cleaning and zero calibration systems to the configuration in Section 1.1.2 above. The recommended piping is shown in the diagram in Section 2.8.3.

For automatic cleaning, the solenoid-operated valve SV2 is installed in the cleaning water pipe as a cleaning water valve, and the pinch valve SV1 below the head tank as a drain valve. For automatic zero calibration, the solenoid-operated valve SV4 is installed in the zero calibration water pipe as a zero calibration water valve, and the motor valve SV3 in the measured-water pipe as a measured water valve.

These valves can be controlled by the automatic cleaning sequence and automatic calibration sequence set in the converter to perform cleaning of the detector's measuring cell and zero calibrations automatically.

1.2 Operating Principle

The operating principle of the Model TB450G NTU-comliant surface scattered Type turbidimeter employs a method of measuring the amount of scattering light on the surface of water. The measuring system comprises a detector and a converter. This section describes the meter configuration and operating principle.

The detector is composed of a measuring cell and a detecting section. Measuring water that flows into the measuring cell from the bottom of the cell overflows at the top of the cell. Meanwhile, a tungsten lamp closed inside the detector emits light onto the surface of the measuring water through a group of lenses. This light is separated into scattered, reflected, and transmitted light on the water's surface. The transmitted light and reflected light are absorbed in a dark area equivalent to a black body.

This scattered-light intensity (L) is proportional to the turbidity as shown here:

$L = K \cdot Q \cdot S$

where K : a constant relative to turbidity,

S : turbidity,

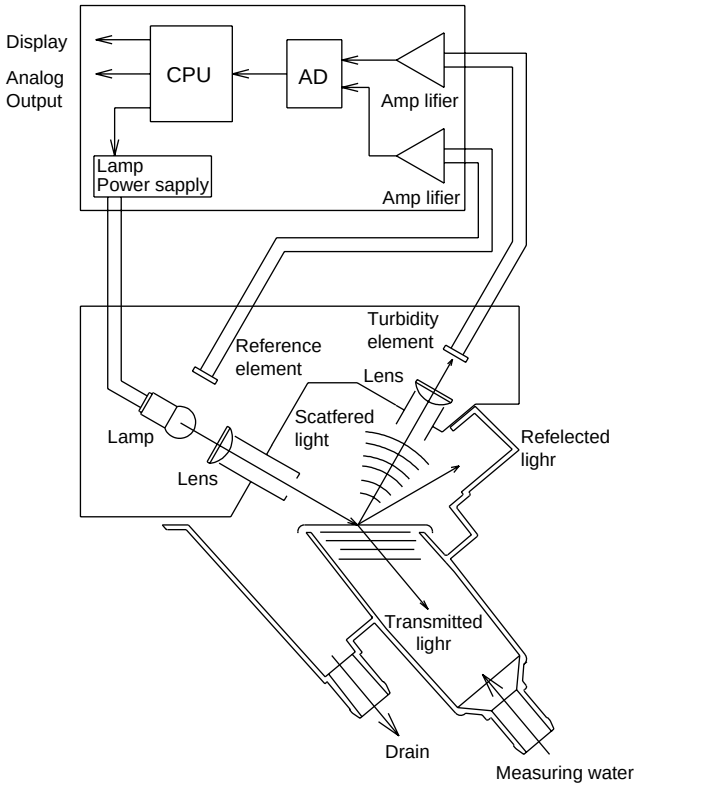
Q : anount of light from the lamp.

The scattered light is detected by a turbidity element (a silicon photodiode) after it is focused onto the element with a lens inside the detecting section in order to output a detection signal to the converter.

In addition, a reference element is incorporated in the detecting section to hold the amount of light (Q) from the lamp constant, and it also outputs a light-detection signal to the converter.

The measuring circuit of the converter is in sealed housing of aluminum alloy together with the operating panel and a terminal block for external wiring. This measuring circuit amplifies and calculates the input from the turbidity element in the detector and outputs a signal (1 to 5 V DC or 4 to 20 mA DC) corresponding to the measuring range.

The converter also calculates the reference element input from the detector to control the lamp voltage so that the amount of light from the lamp is constant.


Display
Analog
Output
CPU
AD
Amp lifier
Lamp
Power sapply
Amp lifier
Turbidity
element
Reference
element
Lens
Scatfered
light
Lamp
Refelected
lighr
Lens
Transmitted
lighr
Drain
Measuring water

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1.3 Turbidity Standard

Calibrations of the zero point and span of a turbidity meter should be performed in reference to the following section on standard liquids.

1.3.1 Standard Water for Zero Calibration

(1) Standard Water for Zero Calibration

Tap water filtrated by a micro filter is used as the standard water for zero calibrations (referred to as zero calibration water).

Tap water should be filtrated with a 1-micron micro filter before using it for zero calibrations. However, if the measuring range is greater than 200 NTU, tap water filter can be used.

Note: The zero point of the TB450G has been calibrated with tap water filtrated with a 0.1-mm micro filter at the factory before shipment.

(2) Micro Filters for Zero Calibration Water

The following shows the recommended specifications of micro filters:

1-micron micro filter

- **Piping connections**: Rc1/2
- **Withstanding pressure**: 780 kPa (8 kgf/cm^2) at 40degC
- **Cartridge**
  - Material: Polypropylene
  - Minimum particle size that can be filtrated: 1 micron
- **Others**: With vent plug

1.3.2 Standard Water for Span Calibration

(1) Standard Water for Span Calibration

The TB450G uses a formazine solution as the standard liquid.

Note: The span calibration for the TB450G has been performed using a formazine solution at the factory before shipment.

(2) Calibration Disk

A calibration disk used for span check during scheduled maintenance, comes with the TB450G.

Note: The turbidity values shown on the calibration disk, which comes with a TB450G, has been scaled for that particular TB450G after performing zero and span calibrations. This means that the calibration disk cannot be used for another turbidity meter. When using two or more turbidity meters, make sure that only the disk that comes with each turbidity meter is used. Also, be extremely careful when handling the calibration disk as damage to the surface of the disk or stains on the disk make its use for calibrations invalid.

2. SPECIFICATIONS

2.1 Standard Specifications

Object of Measurement : turbidity of water in filtration plants and distribution systems, sewage plants, rivers and general industrial processes

Method of Measurement : measurement of scattered-light

Range of measurement : 0 - 10 NTU to 0 - 2000 NTU

Display : 4-digit LED (display resolution of 0.01 NTU, maximum indication of 2200 NTU)

Unit of Display : " NTU "

Output Range : selectable in 3 ranges

Remote selection / local selection (standard) (optional) Auto-range / manual range (standard) (optional) (For auto-range, therange switching point is settable) Can be set to any range within the whole range of measurement.

(However, the span is 20 % or more of the ranges upper setpoint limit or 10 NTU, whichever is greater).

Analog Output Signal : 4 to 20 mA DC (load resistance of up to 550 ohms) or 1 to 5 V DC (output resistance of 100 ohms or less)

Digital Output Signal : conforms to RS-232C interface.

Communication Specifications:

Data Format : ASCII

Data Length : 8 bits

Baud Rate : 1200 bps

Parity : No

Start Bit : 1 bit

Stop Bit : 2 bits

Communication Scheme: mono-directional (transmission only), asynchronous

Communication Data :

Measured Turbidity Value: converter display data (turbidity displayed value) are transmitted.

Data part comprises 6 characters including the sign and decimal point.

(Ex. 1) # 0050.0 $C_R L_F$

(Ex. 2) # 001.00 $C_R L_F$

(Ex. 3) # -00.50 $C_R L_F$

(Ex. 4) #_O.L_ _ $C_R L_F$

* For a " _ _ " (blank), a space code is transmitted.

Upper and Lower Limit Alarm Signal:

continuously transmitted when an upper or lower limit alarm is detected.
#ALARM C_RL_F

Range Output Signal :transmitted once when the range is switched.

Range 1: #RANGE1 C_RL_F
Range 2: #RANGE2 C_RL_F
Range 3: #RANGE3 C_RL_F

Automatic Cleaning / Calibration Signal:

transmitted once at the start and again at the end of automatic cleaning or calibration.

Note: Not transmitted if these are executed manually in the < MAINT. > mode.

start: #CLEANING_START C_RL_F

end: #CLEANING_END C_RL_F

Maintenance / Measurement Signal:

transmitted once when mode is changed.

maintenance: #MAINTENANCE C_RL_F

measurement: #MEASURE C_RL_F

Error Signal :continuously transmitted if a failure occurs.
If there is more than one error, they are transmitted in succession.

#ERR ○○ C_RL_F

○○ : Error number (11, 12, 13, 14, 15, 18, 25, and 26)

(Ex. 1) #ERR11 C_RL_F

(Ex. 2) #ERR11 _ ERRl8 C_RL_F

* For a " _ " (blank), a space code is transmitted.

Data Update Period : approx. 1 second

Cable Length : up to 10m

Contact Output : maintenance output (in maintenance)

failure output (in failure detection)

range output (corresponding to the output range selected) (COM common)

Either upper and lower alarm (standard) or automatic calibra tion or cleaning (optional)

Type of contact output	Contact status at power off	Contact status at power on (Note)	
		Non-operational	Operational
Maintenance	Closed	Open	Closed
Fail	Open	Closed	Open
Upper and lower limit alarm	Closed	Closed	Open
Automatic zero calibration and automatic cleaning	Closed	Open	Closed

Note: The contact output status at power on (open / closed) can be changed.

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Contact Rating:

maximum open / close voltage : 250 V AC or 220 V DC (resistive load)

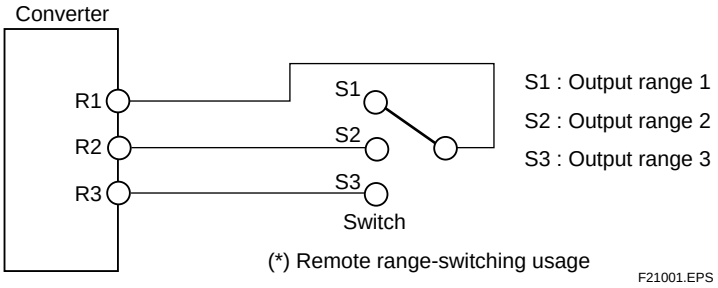
maximum permissible current : 2 A AC or 2 A DC (resistive load)

maximum open / close capacity : 125 VA or 60 W (resistive load)

Contact Input: remote range selection (COM common)

input resistance when on : 200 ohms or less

input resistance when off : 100 k ohms or more



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Converter Functions:

Display Functions:

Data : LED display

turbidity, lamp voltage, current detected by the turbidity element, voltage detected by the reference element, analog output %, analog output mA, zero error, slope

Running operation:

Lamp lit (mode display), characters in relief (other than mode display) < MEAS. > mode, < MAINT. > mode, < PROGRAM. (1,2) > mode, output signal " hold ", under calibration, in cleaning mode, error occurrence

System operation: Characters in relief

Lamp and each solenoid valve

Maintenance Functions (< MAINT. > mode):

Zero calibration, shift calibration, span calibration, sensitivity correction calibration, automatic cleaning manual start, automatic zero-calibration manual start, error code display, error reset, lamp control, and reference value calibration

Setup functions: < PROGRAM.1 > mode:

Output range setting, average coefficient setting, failure output setting, line-segment approximation output setting, upper limit alarm setting, lower limit alarm setting, and bubble retardant setting

< PROGRAM.2 > mode:

Time setting for automatic cleaning, time setting for automatic zero calibration, and selection of execution / stopping of failure detection function

Installation location:

Indoors (for outdoor installation, separate rain-proofing measures are required).

Mounting:

Separate Detector and Converter Units : pipe or rack mounting

Piping Connections for Detector:

Measuring water : ID 25 mm hose connecter

Drain : ID 25 mm hose connecter

Cable Inlet Port: 8 cable glands (bottom of the converter)

Conforming Cable OD : 6 to 12mm dia (without SV2, SV3, SV4), 6.5 to 7mm dia. (for SV2, SV3, SV4)

Type of Wiring : power, analog output, digital output, contact output, contact input, output for solenoid valves (SV1 to SV4) ground (use the converter connecting terminal ground or ground terminal located outside the case).

Measuring Water:

With Sampling System

Flowrate : 1.5 to 2 l/min

Temperature : 0 to 50 degC (but with ambient temperature at + 30 degC or less)

Zero-calibration water

Water Qality : 1 micron filtering water

Flowrate : 1.5 to 2.0 l/min

Temperature : 0 to 50 degC (but with ambient temperature at + 30 degC or less)

Cleaning water : (for the system with sampling system)

Water Quality : Turbidity 2 NTU or less (tap water)

Temperature : 0 to 50 degC (but with ambient temperature at + 30 degC or less)

Flowrate : 3 to 6 l/min

Power Supply : 100 / 110 V AC, 50 /60 Hz, or 200 /220 V AC, 50/60 Hz

Supply voltage:

Single Detector and Converter Units : 70 VA or less

With Sampling System : 250 VA or less (for full loading of recom mended automatic cleaning and zero calibration)

Automatic Cleaning Function:

Water jet cleaning system (cleaning time and cleaning period can be freely set)(for the model with automatic cleaning)

Automatic-Zero Calibration Function:

Zero-point calibration using the zero-calibration water (for the system with automatic cleaning zero calibration)

Failure Detection Function:

Turbidity overrange, lamp disconnection, abnormal lamp voltage, AD circuit failure, Memory failure, and CPU failure

Check Functions : Converter operation check

Manual Calibration :

Zero-Calibration : Using zero-calibration water or light source off zeroing (optional)

Span Calibration : Calibration plate

Other Functions : Line-segment approximation output, upper and lower limit alarm, and output average coefficient setting

Materials:

Detector : Black modified polyphenylene ether (PPE) (wetted part)

Piping : Rigid polyvinyl chloride (PVC), polyethylene, and polypropylene (all used for wetted parts)

Mounting Frame : Carbon steel plates or stainless steel (to be specified)

Converter : Aluminum alloys casting

Coating Finish:

Converter : Polyurethane resin baked coating finish; Color: Munsell 0.6GY3.1 / 2.0 and Munsell 2.5Y8.4/ 1.2

Mounting Frame : Polyurethane resin baked coating finish
Color: Munsell 0.6GY3.1 / 2.0

Ambient Temperature: - 5 to 50 degC (However, if this is the possibility of the measuring water or tap water freezing, countermeasures against freezing are necessary)

Ambient Humidity : 5 to 95% RH (no condensing)

Storage Temperature : - 30 to 70 degC

Mass:

Detector body : Approx. 3.5 kg

Converter body : Approx. 9.5 kg

External Dimensions:

Detector : 316 (W) X 285 (H) X 200 (D) mm

Converter : 260 (W) X 340 (H) X 150 (D) mm

Entire system with mounting frame: 530 (W) X 1450 (H) X 550 (D) mm

2.2 Characteristics

Linearity: When the upper limit value of span is 1000 NTU or less; ±2% of the range upper limit.

When the upper limit value of span is 2000 NTU or less; ±5% of the range upper limit.

Repeatability: 2% of the range upper limit.

Warm-up Time: Approx. 30 minutes

2.3 Model and Suffix Codes

[Style : S1]

Model	Suffix Codes	Option Codes	Description
TB450G			NTU-compliant Surface Scattered Type Turbidity Meter
Measuring Range	-L		Low range (0 to 0.1) to (0 to 100) NTU
	-H		High range (0 to 10) to (0 to 2000) NTU
Output	-4		4 to 20 mA DC
	-5		1 to 5 V DC
Power Supply	-1		100V AC, 50/60Hz
	-3		110V AC, 50/60Hz
	-6		200V AC, 50/60Hz
	-7		220V AC, 50/60Hz
Sampling System	-NN		None sampling system (Note 1)
——	-NN		Always -NN
Optional Specification		/P	Mounting Bracket for Pipe mounting
		/R	Mounting Bracket for Rack mounting
		/SCT	With Stainless Steel Tag-plate

(Note 1) Provide head tank (defoaming tank) so that the flow rate of the water sample reaches the specified flow (1.5 to 2 l/min).

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2.4 Accessories

Name	Q'ty	Remark
Calibration Disk	1	In converter
Silicon Cloth	1	
Lamp	2	Spare
Fuse	4 each	1A, 3A (Spare)
Soft PVC Tube (ø33 Xø25 Black)	1 set (1m X 2)	For detector piping
Clamp	2	For detector piping

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2.5 Spare Parts

Name	Part No.	Recommend (*1)
Change Lamp	K9412AK	1 time / half a year (*2)
1 micron Filter	K9008ZD	1 time / year
Fuse (1A)	A1109EF	1 time / year
Fuse (3A)	A1094EF	1 time / year
Soft PVC Tube 2m (ø33 Xø25 Black)	K9411ZF	1 time / year

(*1) Recommended replace period depends on application condition.
(*2) Please change soon when lamp disconnection (Err12) or lamp life error (Err25) is appeared.

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2.6 Sampling Parts

Name	Part No.
Pinch Valve for Drain water (100, 110V AC)	K9411JG
Pinch Valve for Drain water (200, 220V AC)	K9411JH
Solenoid Valve for Cleaning water or Zero water (100V AC)	A1113MV
Solenoid Valve for Cleaning water or Zero water (110V AC)	A1115MV
Solenoid Valve for Cleaning water or Zero water (200V AC)	A1114MV
Solenoid Valve for Cleaning water or Zero water (220V AC)	A1116MV
Motor Operated Valve for Sampling water (100, 110V AC)	K9411VE
Motor Operated Valve for Sampling water (200, 220V AC)	K9411VF
Head Tank (With Manual Valve)	K9411GC
Head Tank (With Pinch Valve 100, 110V AC)	K9411JA
Head Tank(With Pinch Valve 200, 220V AC)	K9411JB
Mounting Bracket for Head Tank	K9411BB

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2.7 External Dimensions

2.7.1 TB450G-#-#-#-NN-NN

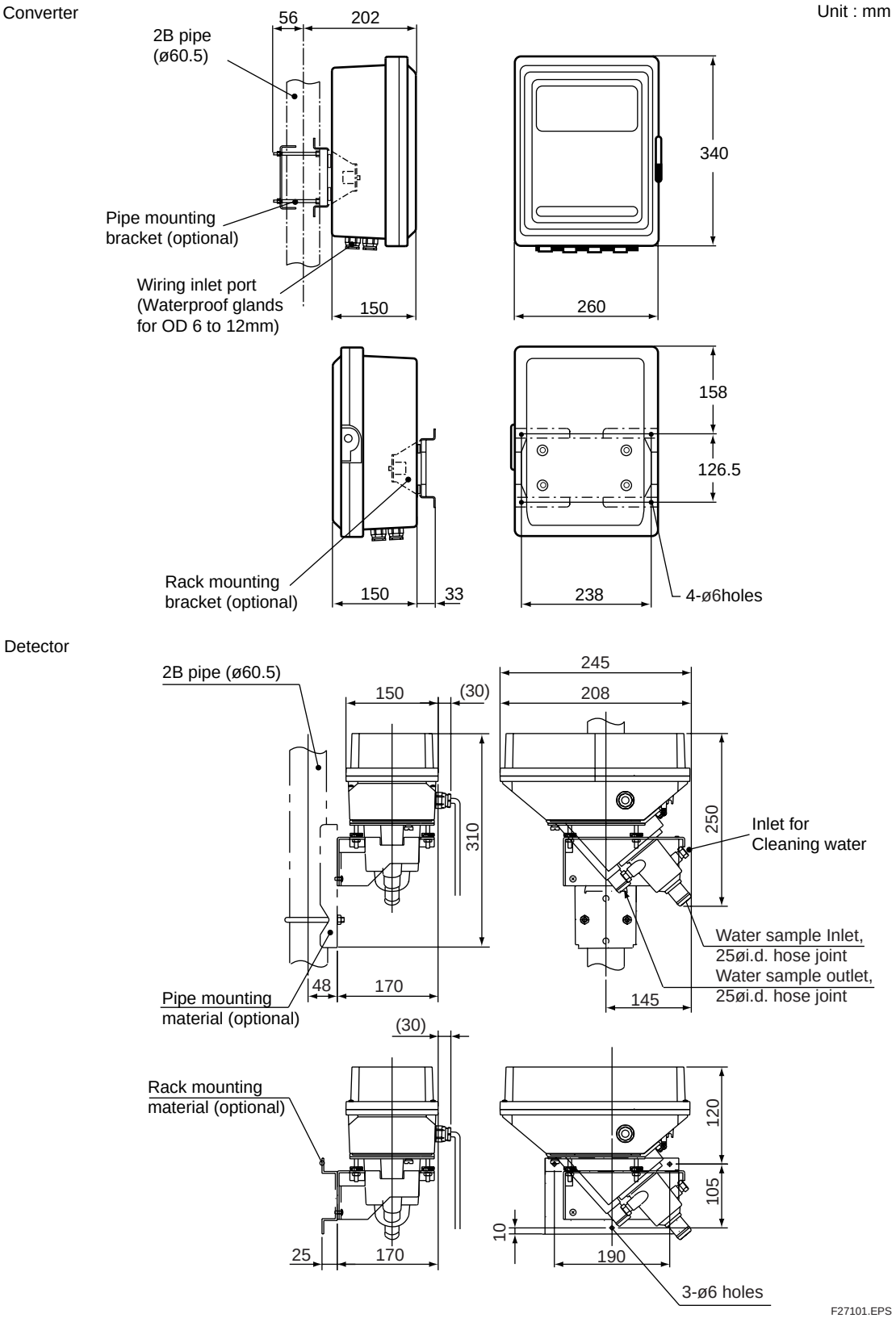
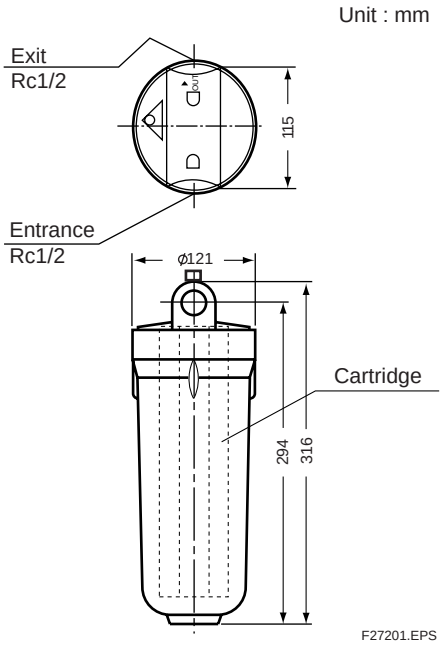
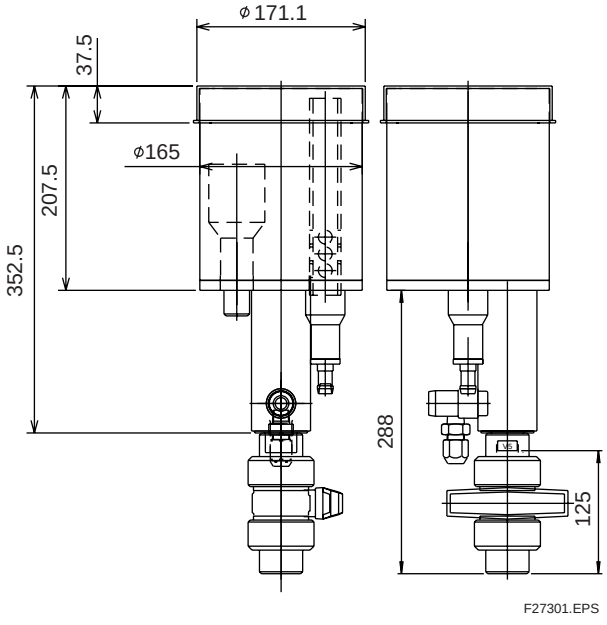


Figure 2.1 External Dimensions of the TB450G-L Scattered-light Turbidimeter

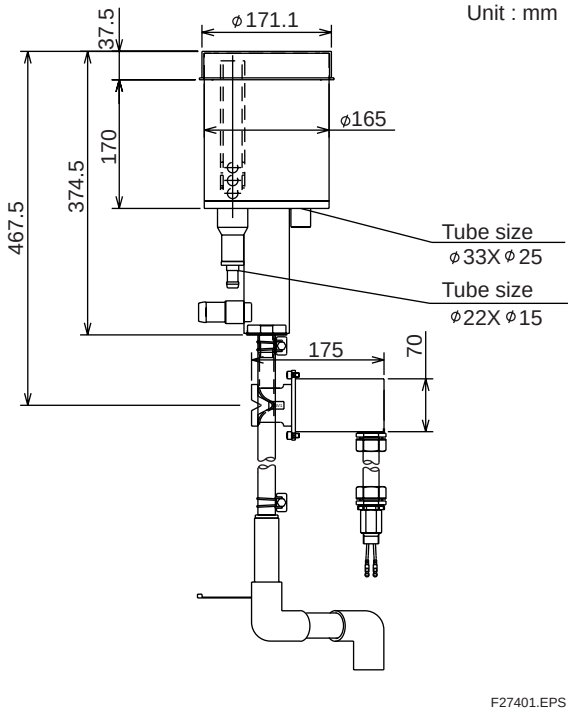
2.7.2 1 micron filter with case (Part No. K9411UA)



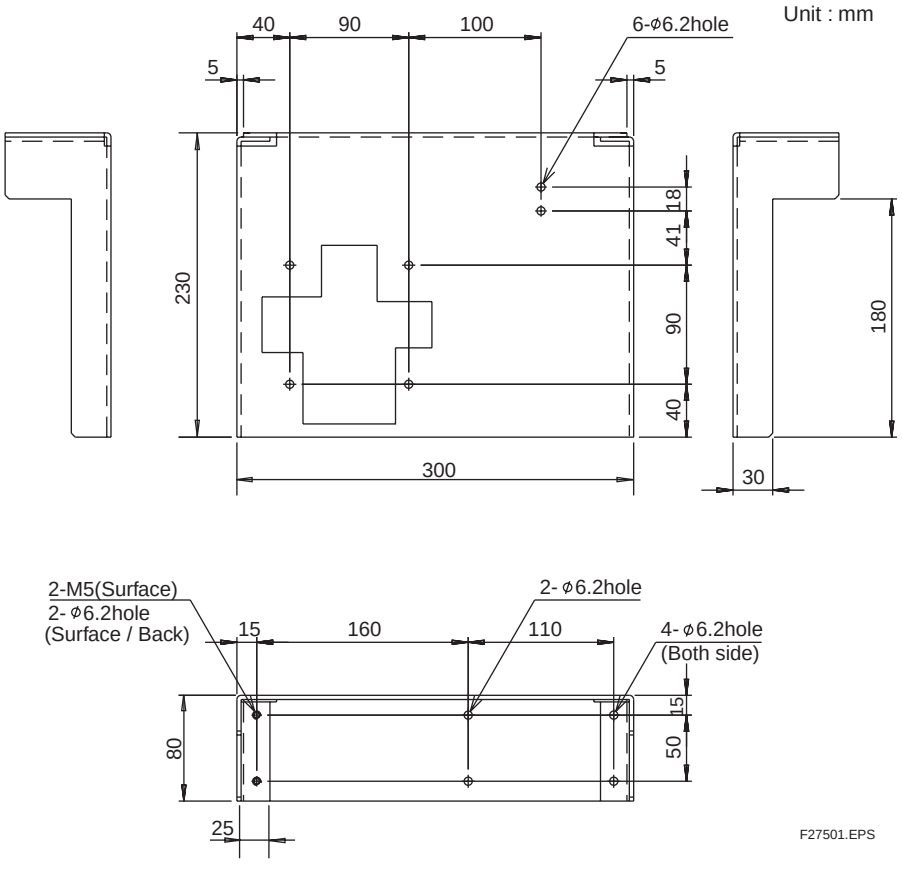
2.7.3 Head Tank (With Manual operated Valve) ; K9411GC;



2.7.4 Head Tank (With Pinch Valve) K9411JA, K9411JB



2.7.5 Mounting Bracket for Head Tank; Part No. K9411BB



2.8 Example Piping Diagram Recommended systems shown below

2.8.1 Without Automatic Cleaning and Automatic Zero Calibration

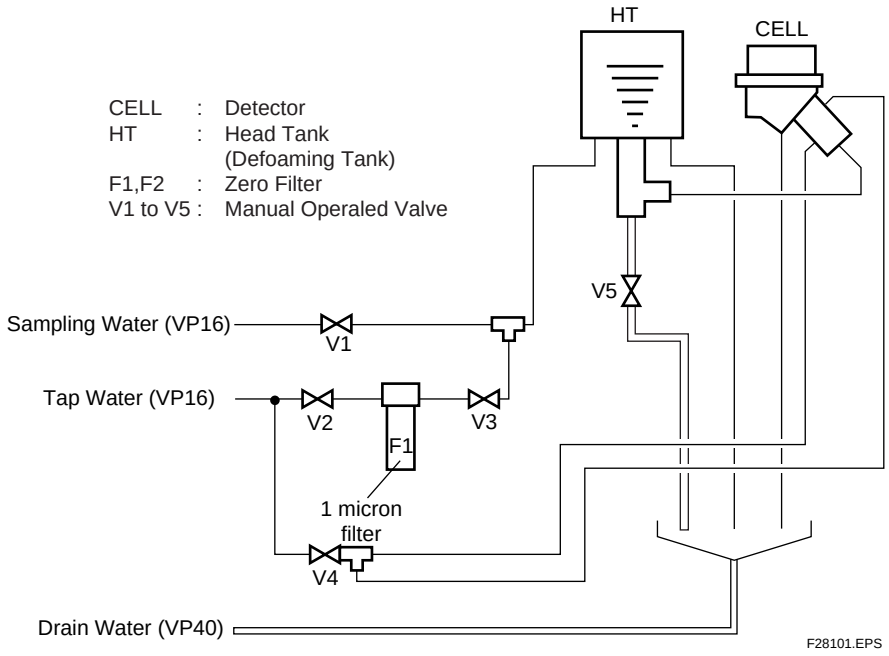


Figure 2.5

2.8.2 With Automatic Cleaning without Automatic Zero Calibration

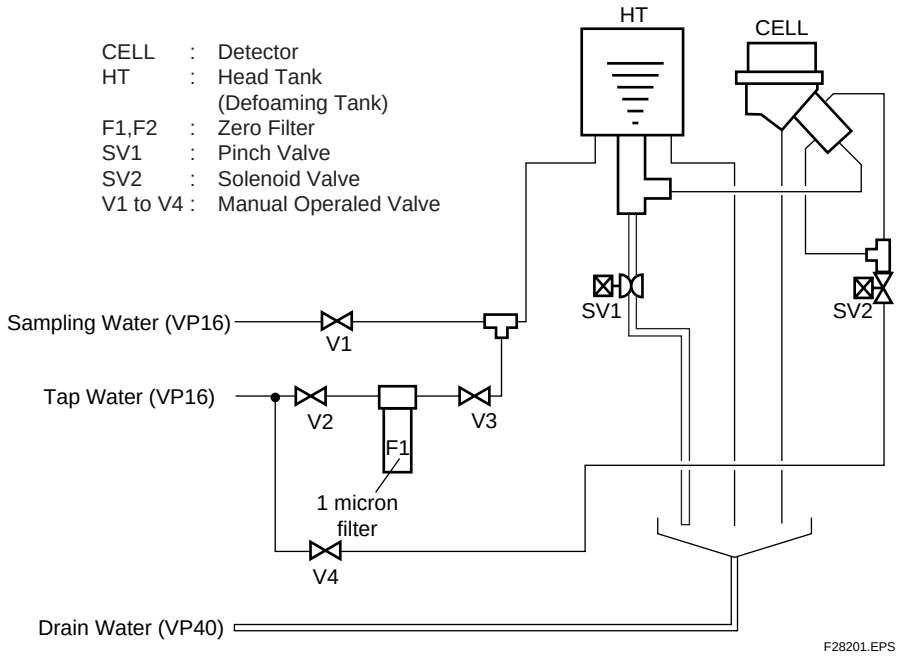


Figure 2.6

2.8.3 With Aotomatic Cleaning and Automatic Zero Calibration

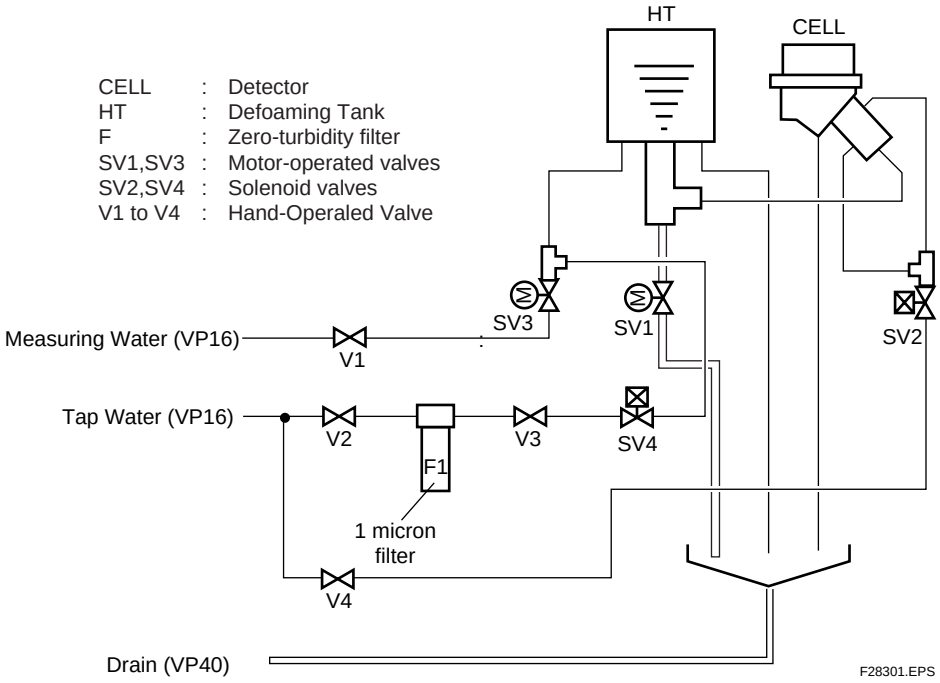
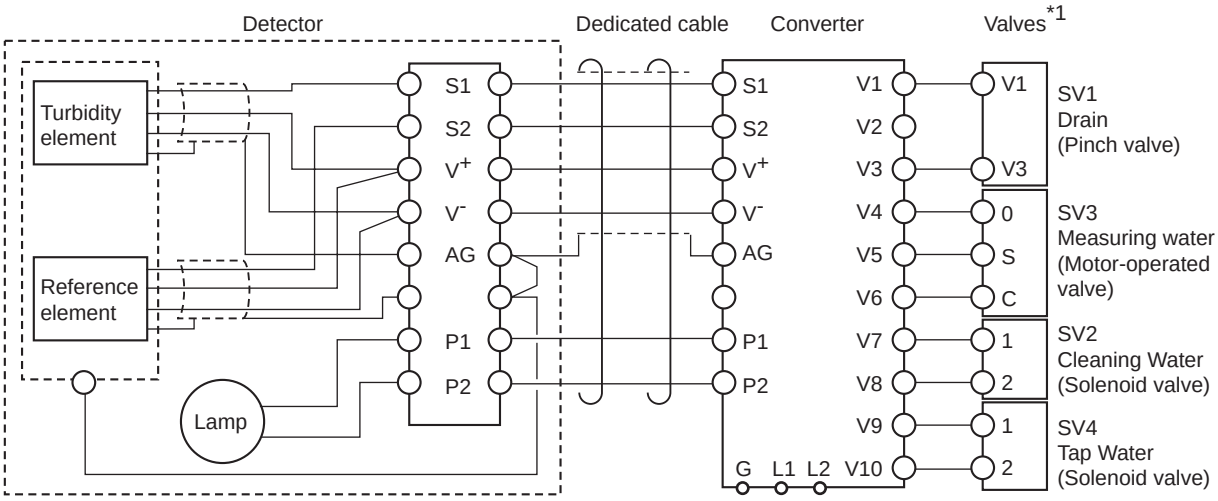


Figure 2.7

2.9 Internal Wiring Diagram

Figure 2.8 shows the internal wiring diagram of the turbidimeter with a sampling system. For external wiring, see Section 3.3.

A dedicated cable is shipped connected to the detector.



(*1) Valve connections vary with the specifications as shown below.

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Configuration	Diagram of Recommended Piping	Valves Used
Only converter and detector		None
With sampling system	See Section 2.8.1	None
With sampling system and automatic cleaning system	See Section 2.8.2	SV1, SV2
With sampling system, automatic cleaning system, and automatic zero calibration system	See Section 2.8.3	SV1, SV2 SV3, SV4

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Figure 2.8 System configuration and Connections

3. INSTALLATION. PIPING. AND WIRING

3.1 Installation

3.1.1 Unpacking

The NTU-compliant surface scattered type turbidimeter is shipped after being sufficiently packed so as not to be damaged during transportation. When the turbidimeter is delivered, unpack the meter carefully. If the turbidimeter with a sampling system is delivered, unpack them near the location where they are to be installed.

3.1.2 Installation Location

The NTU-compliant surface scattered type turbidimeter should be installed in a location where:

(1) rainwater cannot get inside, such as in a building or a cubicle,

(2) there is little vibration,

(3) there are few corrosive gases,

(4) there is not much humidity,

(5) there is little temperature change and the temperature is maintained around normal,

(6) there is enough clearance for maintenance and maintenance work can be easily done,

(7) drain-off can be well provided.

3.1.3 Installation

Installation of the NTU-compliant surface scattered type turbidimeter need to mount the detector and converter onto pipes (nominal diameter of 50 mm) or racks with the special mounting bracket. Note that these brackets are only supplied when the user has specified them.

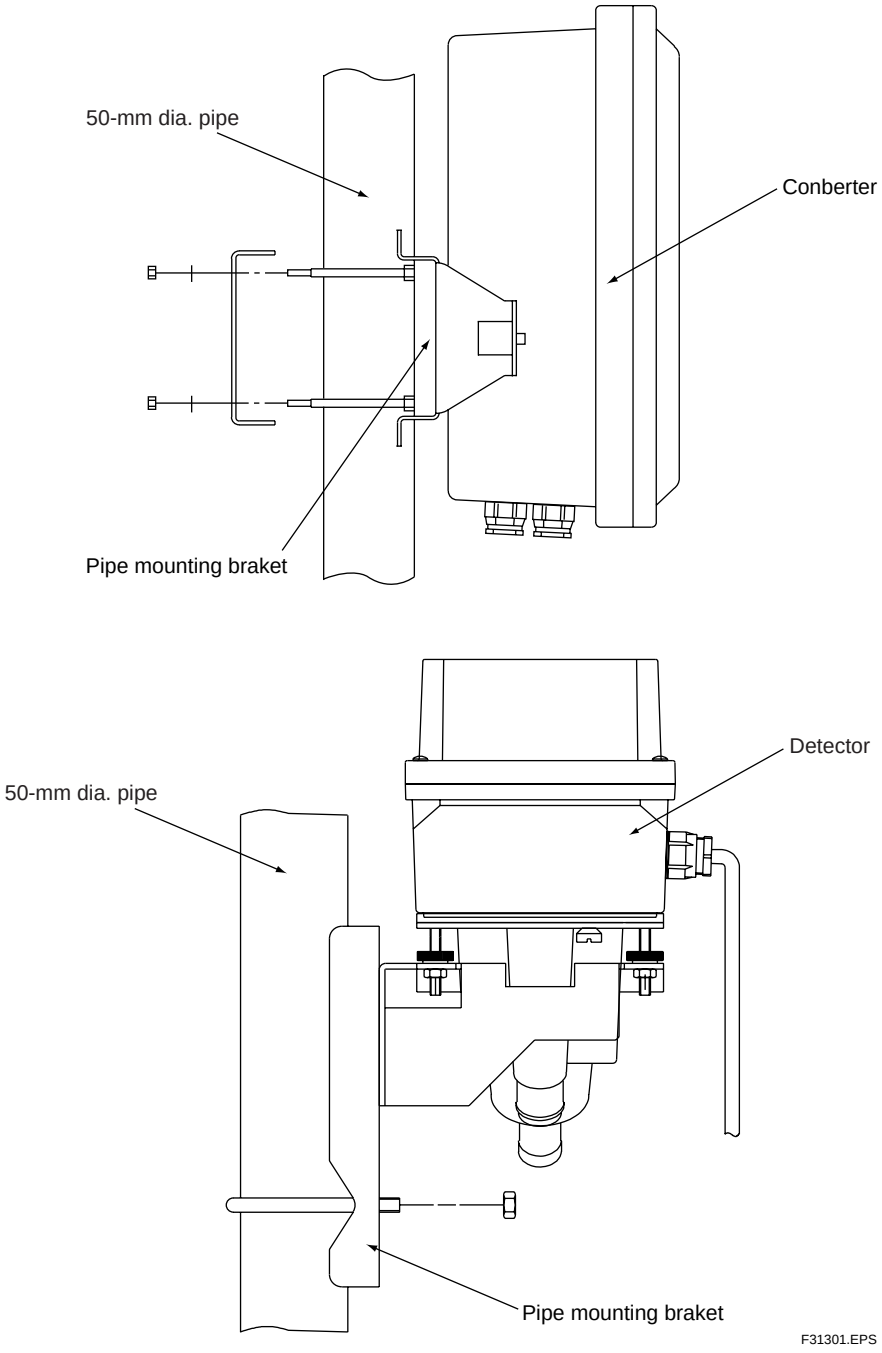

Figure 3.1 Pipe Mounting

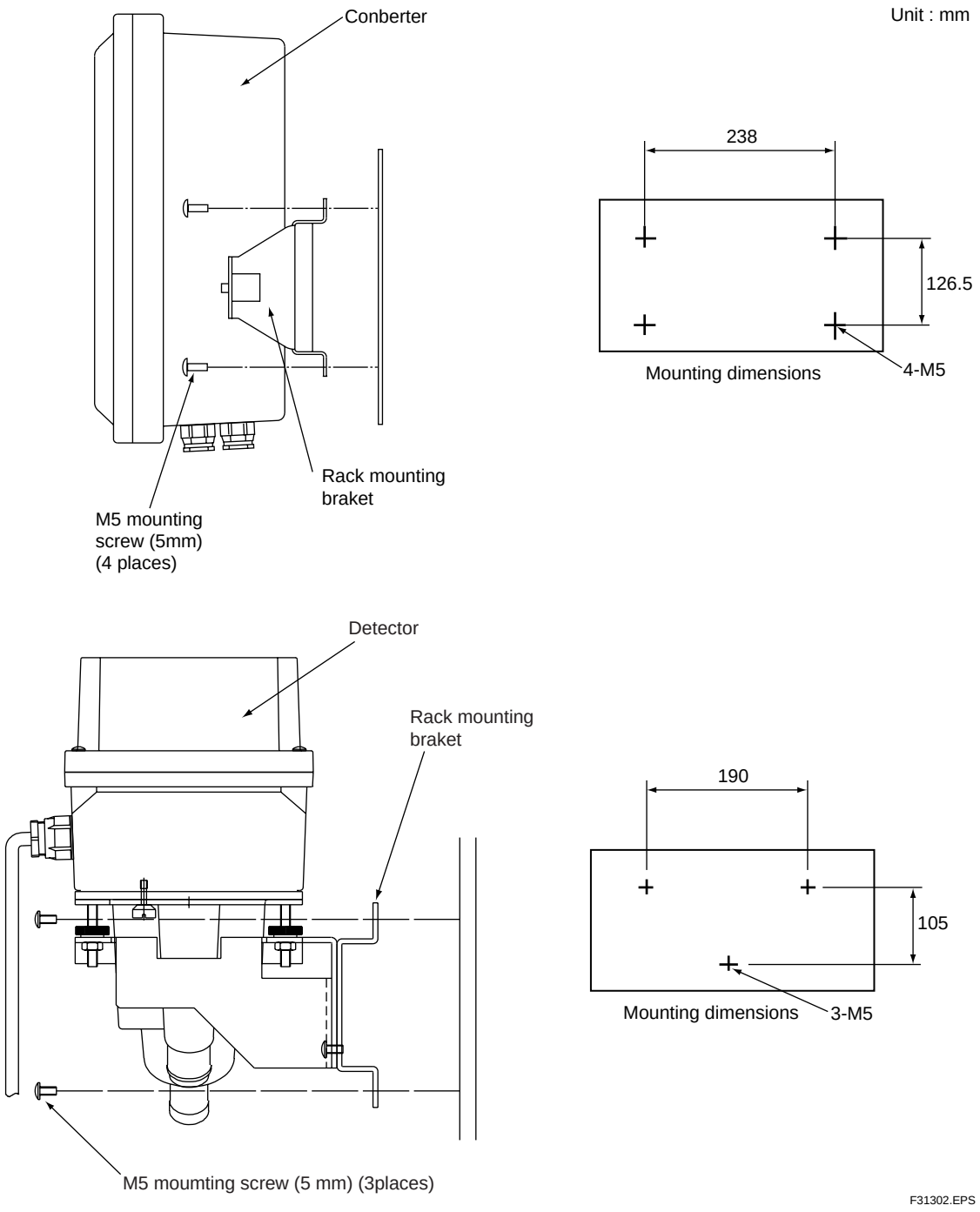

Figure 3.2 Rack Mounting

3.2 Piping

3.2.1 When Using TB450G Converter and Detector Alone

(1) Piping for Measured Water

To meet the requirement of the flow rate (1.5 to 2.0 L/min), provide a head tank that also works as a deaeration tank (constant-level tank) and connect the measured water supply to the head tank. The head tank needs to be installed at an adequate height so as to regulate the flow rate between 1.5 and 2.0 L/min. Refer to figures 3.3 and 3.4, which show the structure of a head tank and the relationship between the positions of the head tank and detector.

For the piping between the head tank and detector, use the black soft PVC tube (O.D. 33 / I.D. 25 mm) that comes with the TG450G. Prevent clogging and bubbles from collecting inside the tube, by cutting the tube to an adequate length to ensure that no bends occur or water or bubbles become trapped.

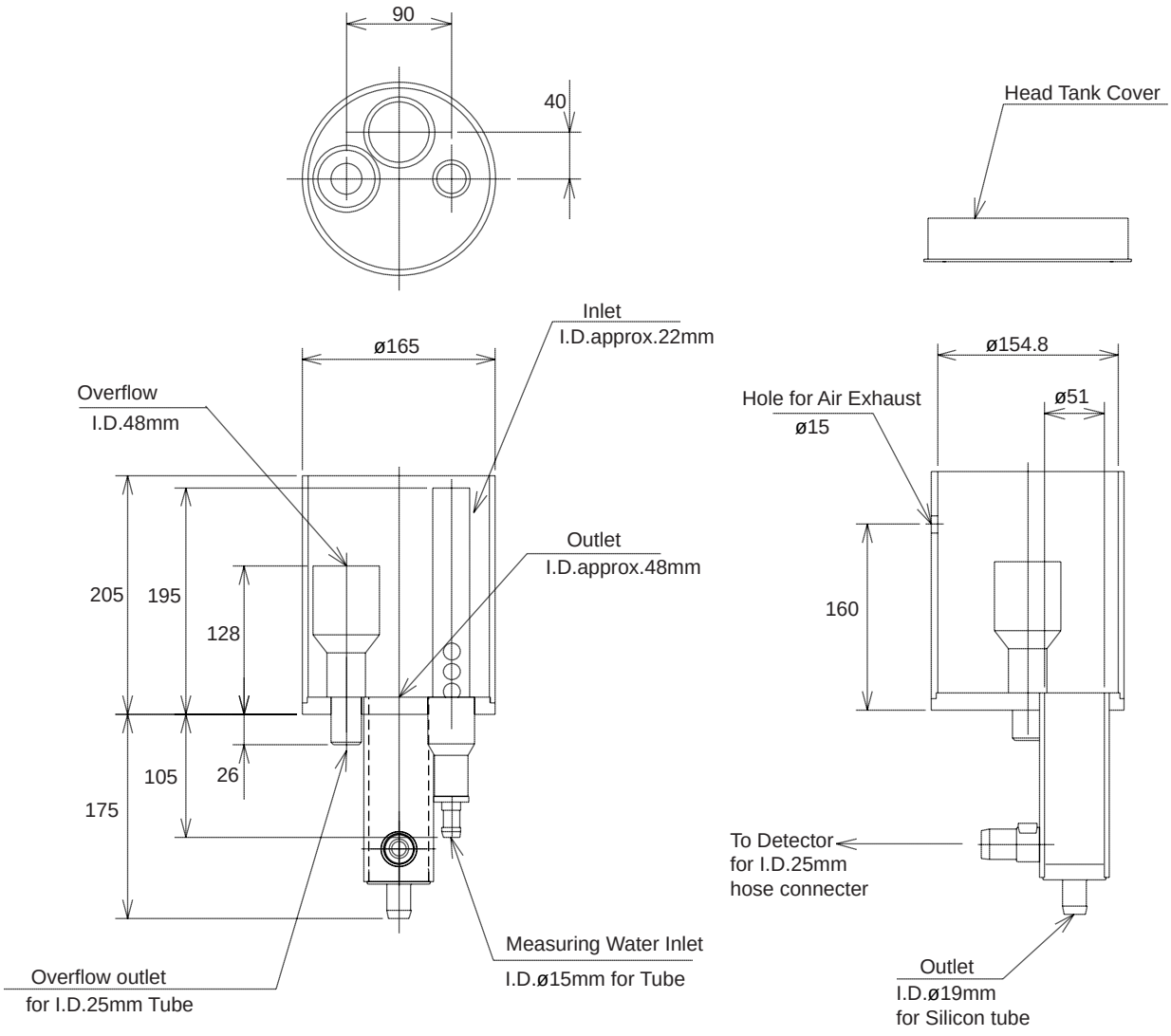

Figure 3.3 External Dimensions of Head Tank

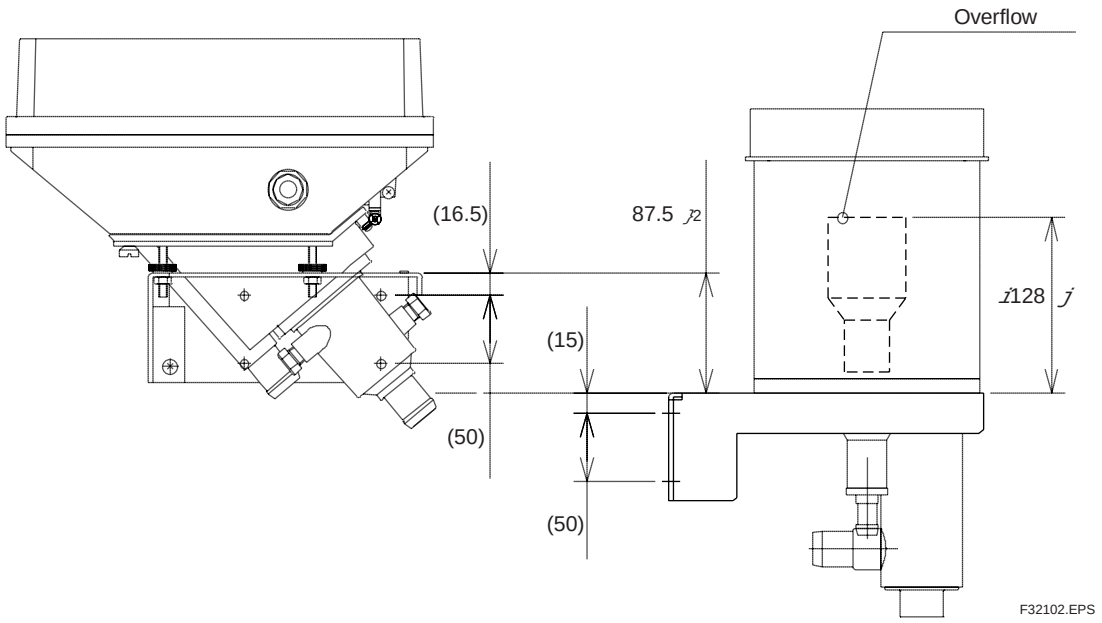

Figure 3.4 Relationship between Positions of Head Tank and Detector

(2) Drain Piping

Connect the piece of the black soft PVC tube (O.D. 33 / I.D. 25 mm) that comes with the TG450G, and place the other side of the tube in a drain ditch or the like. When laying the tube, be careful to lay it in such a way that no bends occur or water or bubbles become trapped. Water trapped in the drain pipe may cause the detector's measuring cell to overflow.

(3) Piping for Zero Calibration Water

As the zero calibration water, tap water is filtrated and fed to the detector. As with the measured water, the zero calibration water must also be connected to the head tank to meet the requirement of the flow rate of the water fed to the detector. Provide a switching valve on the inlet of the head tank (described in Item (1)) and connect the zero calibration water pipe to the valve so as to allow feed to the head tank to be switched over between the measured water and zero calibration water.

To use tap water for zero calibrations, it should be filtrated with a 1 micron micro filter. However, if the measuring range is greater than 200 NTU, tap water can be used. For the specifications required for the micro filters, see Section 1.3.

(4) Piping for Cleaning Water

A plug is equipped at the cleaning water inlet of the detector. For connection of the cleaning water pipe, see Section 3.2.2.

(5) Precautions for Piping

For all connections to the detector, be sure to use the black soft PVC tube (O.D. 33 / I.D. 25 mm) that comes with the TG450G, to shield them from light. For other portions of piping, hard or soft PVC pipes are recommended.

For measured-water and zero calibration water pipes, avoid clogging and bubbles from collecting inside the pipes by preventing, as much as possible, kinks or water becoming trapped.

3.2.2 When Using TB450G with Sampling System

Refer to the piping diagram shown in Section 2.8, when designing and manufacturing the sampling system. Be sure to at least provide the head tank, filters for zero calibration water, and valves V1, V2, V3, V4, and V5 shown in this diagram.

When using the automatic cleaning function and automatic zero calibration function of the TB450G, refer to Sections 2.8.2 and 2.8.3 and in addition provide the pinch, motor, and solenoid-operated valves shown as SV1, SV2, SV3, and SV4.

The following describes the precautions for each pipe.

(1) Piping for Measured Water

Piping for measured water denotes piping for feeding the measured water to the detector.

Provide a head tank that also works as a deaeration tank (constant-level tank) and connect the measured water supply to the head tank. For installation and piping, see Item (1) in Section 3.2.1. For the pipe leading the measured water to the head tank, a hard PVC pipe (VP16 or higher) or soft PVC tube (I.D. 15 mm or larger) is recommended.

For cleaning of the detector and head tank, refer to Section 2.8.1 and provide drain piping with the hand-operated valve V5 for the head tank. A hard PVC pipe (VP25 or higher) or soft PVC tube (I.D. 25 mm or larger) is recommended for the drain pipe, and a ball valve is recommended for the hand-operated valve (V5 in the diagram).

When using the automatic cleaning function of the TB450G, refer to Sections 2.8.2.and 2.8.3 and provide the pinch valve SV1 for the drain pipe below the head tank instead of the hand-operated valve V5. For the drain pipe, use a tube that meets the specifications of the pinch valve. When using the automatic calibration function of the TB450G, refer to Section 2.8.3 and provide the pinch valve SV1 as well as the motor valve SV3 for switching over the feed to the head tank between the measured water and zero calibration water.

The following shows the recommended specifications of the pinch valve SV1 and motor-operated valve SV3:

Pinch valve SV1

- Working pressure : 0 to 10 kPa
- Connection tubes : O.D. 23 / I.D. 19 mm silicon tube
- Power supply : As specified for TB450G
- Maximum power consumption : 60 W
- Cable inlet port : Applicable to an O.D. 6 to 12 mm cable
- Protection class : Waterproof
- Insulation resistance : 100 M ohms or greater
- Withstanding voltage : 1000 V AC for 1 minute

Motor-operated valve SV3

- Type : Ball valve with motor actuator
- Working pressure : 0 to 1 MPa
- Fluid temperature : 0 degC to 50 degC
- Nominal size : 1/2 inch (15 mm)
- Cv : 12
- Process connections : TS sockets
- Rated torque : 3 N·m (30 kg·cm)
- Open-close time : 4.5 to 5.4 seconds
- Motor type : Inductor synchronous motor
- Motor protection : With built-in thermal protector

- Power supply : As specified for TB450G
- Maximum power consumption : 14 VA or 8 W
- Cable inlet port : Applicable to an O.D. 6.5 to 7 mm cable
- Protection class : Rainproof for outdoor-use
- Materials
  - Body and ball : Hard PVC
  - Sheet : PTFE
  - Seal : EPDM
- Ambient temperature : –20 degC to 60 degC

(2) Piping for Tap Water

Piping for tap water denotes piping for feeding cleaning water and zero calibration water to the detector.

Use tap water as the cleaning water. Connect polyethylene or polypropylene tubes of O.D. 8 mm and I.D. 6 mm to the Rc1/4 cleaning water ports on the sides of the detector using adequate fittings. When using the automatic cleaning function of the TB450G, refer to Sections 2.8.2.and 2.8.3 and provide the solenoid-operated valve SV2 for the cleaning water pipe.

Tap water filtrated by micro filters is used as the zero calibration water. For the piping method, see Item (3) in Section 3.2.1. When using the automatic calibration function of the TB450G, refer to Section 2.8.3 and provide the solenoid-operated valve SV4 in the zero calibration water pipe.

Note: Do not use transparent or semitrans parent fittings for connecting tubes to the detector.

The following shows the recommended specifications of solenoid-operated valves SV2 and SV4:

Solenoid valves SV2/SV4

- Type : Two-port solenoid-operated directional valve
- Applicable fluid : Water
- Working pressure : 0 to 1.5 MPa
- Withstanding pressure : 5.0 MPa (water)
- Fluid temperature : 1 to 60 degC
- Cv : 0.8
- Process connections : Rc3/8
- Power supply : As specified for TB450G
- Maximum power consumption : 7.5 VA
- Cable inlet port : Applicable to an O.D. 6.5 to 7 mm cable
- Protection class : Waterproof
- Materials
  - Body : Brass or stainless steel
  - Sheet : Nitrile rubber
- Ambient temperature: –20 degC to 60 degC

For the pipe of the tap water supply, a hard PVC pipe (VP16 or higher) or soft PVC tube (I.D. 15 mm or larger) is recommended.

(3) Drain Piping

Drain piping denotes piping for discharging the measured water and tap water from the detector to a drain ditch or the like. When laying piping, be careful that no bends occur or water or bubbles become trapped as this may cause deposit to build up or a delay in the flow to occur in the piping. For the drain pipe, a hard PVC pipe (VP40 (VU40) or higher) is recommended.

3.3 Wiring

There are the following categories for wiring to the turbidimeter:

(1) Wiring for detector and conveter

(2) Wiring converter and valves (SV1,SV2) when automatic cleaning added

(3) Wiring converter and valves (SV1,SV2,SV3,SV4) when automatic cleaning and automatic zero calibration added

(4) Wiring for power supply and grounding

(5) Analog output wiring

(6) Digital output wiring

(7) Contact input (remote range selection) wiring and contact output (range output) wiring (if necessary)

(8) Contact output (maintenance, failure, upper and lower limit alarms, or automatic zero calibration / cleaning outputs) wiring (if necessary)

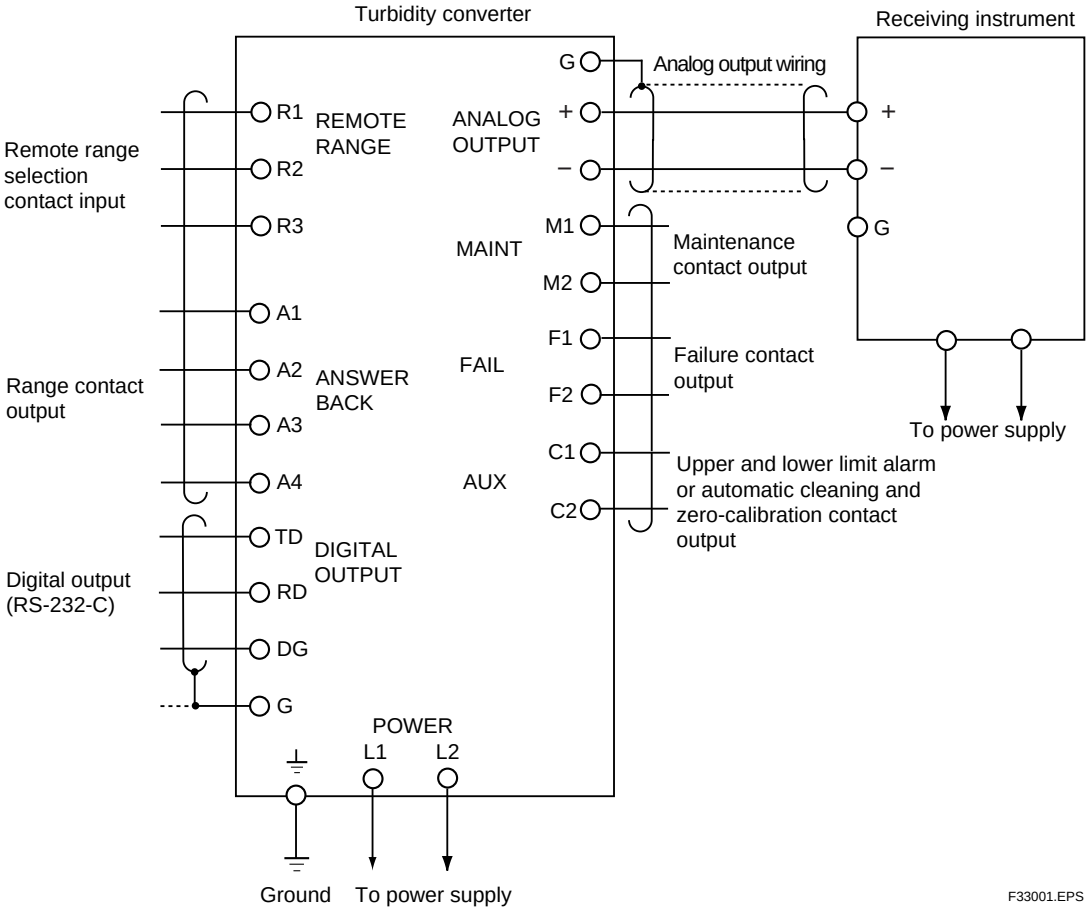

Figure 3.5 Wiring Diagram

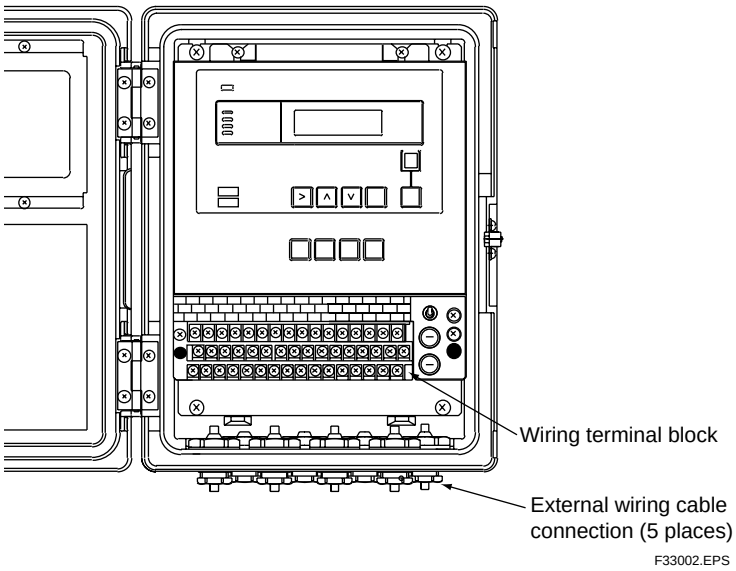

Figure 3.6 Converter External Wiring Terminal Block and Cable Connections

For each cable wiring, refer to figure 3.5 and 3.6 " wiring diagrams " in the section 2.9.

Note: Be sure to insert cable glands with blind plugs into the unused cable connections.

3.3.1 Wiring between Converter and Detector

Connect the converter to the detector with the dedicated cable that was already connected to the detector when it was delivered. Remove the drip-proof cap plug capped in a cable gland of the converter, and connect the other side of the cable to the converter.

3.3.2 Wiring between Converter and Valves SV1/2 – when Using Automatic Cleaning Function

When using the automatic cleaning function, wiring from converter to the pinch valve SV1 (drain valve) and solenoid-operated valve SV2 (cleaning water valve) must be performed. Remove the drip-proof cap plugs capped to the cable glands of the converter, and perform the wiring.

For the wiring to the pinch valve SV1, use a 2-core cable of O.D. 6 to 12 mm.

For the wiring to the solenoid-operated valve SV2, use a 2-core cable of O.D. 6.5 to 7 mm.

Note: Do not remove the drip-proof plugs from cable glands that are not used.

3.3.3 Wiring between Converter and Valves SV1/2/3/4 – when Using Automatic Cleaning Function and

Automatic Zero Calibration Function

When using the automatic cleaning function, the wiring from the converter to the following valves must be performed with the respective cables:

- Pinch valve SV1 (drain valve), with a 2-core cable of O.D. 6 to 12 mm
- Solenoid-operated valve SV2 (cleaning water valve), with a 2-core cable of O.D. 6.5 to 7 mm
- Motor-operated valve SV3 (measured water valve), with a 3-core cable of O.D. 6.5 to 7 mm
- Solenoid-operated valve SV4 (zero calibration water valve), with a 2-core cable of O.D. 6.5 to 7 mm

Remove the drip-proof cap plugs capped to the cable glands of the converter, and perform the wiring.

For the wiring to motor valve SV3, be careful with the connections to the converter terminals V4 (open), V5 (shut), and V6 (common). The voltages output from these terminals are as follows:

- When opening SV3 – V4–V6: Power supply voltage
  – V5–V6: 0 V
- When shutting SV3 – V4–V6: 0 V
  – V5–V6: Power supply voltage

Check the specification of the motor valve and perform correct wiring.

3.3.4 Power and Grounding Wiring

[Power Wiring]

This is the wiring to supply power, conforming to the frequency and voltage specifications, to the converter. Connect converter terminals L1 and L2 with the power supply.

Use a two-conductor cable having a finished OD of 6 to 12 mm for the power wiring.

The cable end-treatment procedure for the end to be connected to the converter is described in the following:

(1) Strip off about 80 mm of the cable insulation covering from the end.

(2) Attach clamp terminal lugs fitted to M4 (4 mm) screws to the tips of the conductors.

[Grounding Wiring]

Do the grounding wiring using the grounding terminal at the bottom of the converter case. As the grounding terminal is for an M5 (5 mm) screw, connect a grounding conductor whose end is end-treated (obtaining sufficient continuity) and do the grounding (JIS class 3, grounding resistance of 100 OHMS or less).

Note: If grounding cannot be done using the ground terminal of the converter case, connect the grounding conductor to terminal G (M4 (4 mm) screw) within the converter and ground the conductor on the power supply side. In this case, use 3-conductor or 2-conductor shielded cables for the power and grounding wiring.

3.3.5 Analog Output Wiring

This is the wiring for transmitting a 1 to 5 V DC or 4 to 20 mA DC output signal corresponding to the output range to a receiving instrument such as a recorder.

For wiring, use a 2-conductor shielded cable of finished OD 6 to 12 mm. The cable end-treatment procedure and connection procedures on the connecting side to the converter are shown below.

(1) Strip off about 40 mm of the insulation covering and shield from the cable end and solder a leadwire to the root of the exposed shield. Protect the soldered part with wound insulation tape.

(2) Make the soldered leadwire length almost the same as other conductor lengths and attach crimp terminal lugs conforming to an M4 (4 mm) screw to the tips of each conductor and this leadwire.

(3) Connect the cable to the converter terminals + and -. Connect the plus pole conductor to the OUTPUT " + " terminal and the minus pole conductor to the OUTPUT " - " terminal. Also, connect the leadwire of the shield to terminal G. (Do not ground the shield on the receiving side.)

3.3.6 Digital Output Wiring

This is the wiring for outputting turbidity signals and generated failure details as digital signals (through RS232-C). For details of specifications and transmission, see Section 2.1, " Standard Specifications ".

For wiring, use a 3-conductor shielded cable of finished OD 6 to 12 mm. Limit the cable length up 10 m.

The cable end-treatment procedure and connection procedures on the connecting side to the converter are shown below.

(1) Strip off about 40 mm of the insulation covering and shield from the cable end and solder a leadwire to the root of the exposed shield. Protect the soldered part with wound insulation tape.

(2) Make the soldered leadwire length almost the same as other conductor lengths and attach crimp terminal lugs conforming to an M4 (4 mm) screw to the tips of each conductor and this leadwire.

(3) Connect the cable to the converter terminals (TD, RD, DG, and G). Connect the conductors as shown in Figure 3.7. (Do not ground the shield on the receiving side).

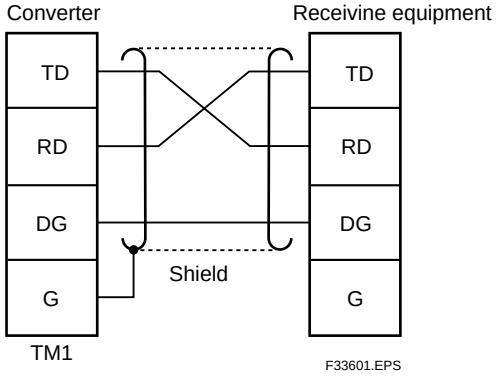

Figure 3.7 Wiring diagram for digital output

3.3.7 Contact Input (Remote Range Swtiching) and Contact Output (Range Output) Wiring (If necessary)

As output ranges, three types of ranges can be set, and output can be obtained by freely switching these ranges. The output range selection is “ remote”, “ local ” or “ auto ” mode.

This wiring is applied if the range is changed in “ remote ” mode (see Section 6.6 (12)) or the range contact output is used.

Use a 2-conductor cable of finished OD 6 to 12 mm for the wiring. However, use a 3-conductor cable when remote range selection only is used and a 4-conductor cable when only range contact output is used.

The on and off contact statuses are identified with the resistance value conditions shown in Table 3.1. In doing wiring, confirm that a contact meeting these conditions is used.

Table 3.1 On/off Identification of Contact Input for Switching “ Remote Range”

	On status identification	Off status identification
Resistance value (contact)	200 Ω or less	100 kΩ or more

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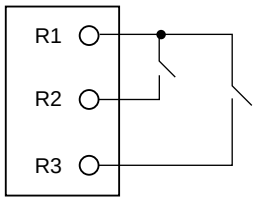
The cable end-treatment procedure and connection procedures on the converter connection side are shown below.

(1) Strip off about 40 mm of the cable insulation covering from the end and attach suitable terminal lugs fitted to M4 (4 mm) screws to the tip of each conductor.

(2) Connect the cable conductors to “ remote ” range selection terminals R1, R2, and R3 and range contact output terminals A1, A2, A3 and A4.

“Remote range” switching on / off contact input is performed between terminals R1 and R2, and between terminals R1 and R3 (See figure 3.9). The relationship between the on / off contact input and the output range is as shown in Table 3.2.

Table 3.2 Contact Input and Output Range



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R1-R2	R1-R3	Output range
OFF	OFF	RANGE 1
ON	OFF	RANGE 2
OFF	ON	RANGE 3

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Figure 3.8 contact output range

The range contacts can be output as in Figure 3.9.

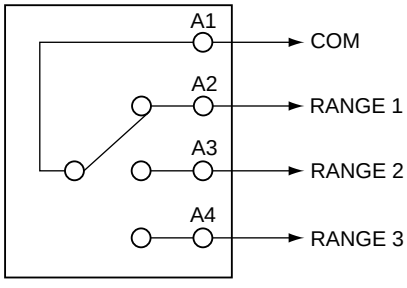

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Figure 3.9 Range Contact Output

3.3.8 Contact Output (During maintenance, failure, upper or lower limit alarm, during automatic cleaning, during automatic zero calibration) Wiring (If necessary)

The converter outputs contact signals for failure, maintenance, and upper and lower limit alarm or automatic cleaning / in calibration. Use a finished OD 6 to 12 mm cable for this wiring (select a 2-, 3-, or 6-conductor cable depending on the number of contact outputs used). The contact rating for contact output relays is as shown in Table 3.3. For the instrument to be connected, select that which satisfies the conditions in Table 3.3.

Table 3.3 Contact Rating for Contact Output Relay

	DC relay	AC relay
Maximum permissible contact voltage	220 V	250 V
Maximum permissible contact current	2 A	2 A
Maximum permissible contact power	60 W	125 VA

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Connect each conductor of the cable to terminals F1, F2, M1, M2, C1, and C2 respectively. Before connection, end-treat the cable conductors. Strip off the cable insulation covering by about 40 mm and attach crimp terminal lugs conforming to M4 (4 mm) screws to each conductor.

Table 3.4 shows the operation of each contact output.

Table 3.4 Contact Output Operation

Contact	Operation
M1, M2	Closed (setting upon shipment from the factory) for maintenance (other than the < MEAS. > mode). (*2)
F1, F2	Open when a failure occurs (setting upon shipment from the factory). (*2)
C1, C2 (*1)	Open when the upper or lower alarm is generated (at shipment from the factory). (*2) or Closed during automatic calibration or automatic cleaning. (*2)

(*1) Contacts C1 and C2 can be used in two ways: for upper and lower limit alarms and for automatic cleaning and calibration. These can be selected with FUNCTION " E " in the < PROGRAM1 > mode. When shipped from the factory, this is set for the upper and lower alarms.

(*2) Either open or closed can be selected when the contact operates. Set them with FUNCTIONs " C " to " F " in the < PROGRAM2 > mode.

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4. OPERATION

4.1 Preparation for Operation

For preparation, proceed with the work in turn according to the items in subsections 4.1.1 to 4.1.10.

Since the types and number of valves vary with the specifications for sampling, see the piping diagrams in Section 2.8. For meaning of the codes, see Section 2.3.

CAUTION

When the detector is opened for preparation, take extreme care not to get the lenses in the detector (in two places) dirty. If they get dirty, clean the lenses (see Section 7.8).

4.1.1 Checking Piping and Wiring Conditions

Examine that the piping and wiring have been done properly.

4.1.2 Supplying Power

First confirm that the power supply is of the voltage andfrequency that meet the specifications. Also, check that the cap of the fuse holder in the converter is securely tightened. Turn on thepower switch in the converter.Then, press the [MODE] key on the converter to go to the <MAINT.> mode.

4.1.3 Setting Sampling Specification

To enable the automatic cleaning and zero calibration functions, the FUNCTION " 9 " setting in the section 6.6 (22) <PROGRAM1> mode must be made according to the specifications of the sampling system assembled with the TB450G, as follows:

1) Press the [MODE] key of the converter to change the mode to <PROGRAM1>, and call FUNCTION " 9. "
2) The code currently set is then displayed ("____1" for example).
3) According to the specifications of the sampling system used, change the code as necessary using the [>] key and press the [ENT] key to set the code.
   - Code ____1: When using a TB450G converter and detector solely or when assembling it with a simple sampling system as shown in Section 2.8.1.
   - Code ____2: When assembling a TB450G converter with an automatic sampling system as shown in Section 2.8.2.
   - Code ____3: When assembling a TB450G converter with automatic sampling and zero calibration systems as shown in Section 2.8.3.
4) Press the [MODE] key to change the mode to <MAINT.>.

Note 1: Be sure to set the correct code that meets the specifications of the sampling system used. Otherwise, correct turbidity measurements may not be performed.

4.1.4 Feeding Zero Calibration Water

1) Feed the tap water to the zero-turbidity filters.

2) Shut all valves except V2 and SV4.

Note 1: SV4 exists only when automatic calibration is used (see Sections 2.8.1 and 2.8.2).

Note 2: Use the valve operation key of the converter to manipulate SV1, SV2, SV3, and SV4.

3) Loosen the vent plugs at the top of zero-turbidity filters and vent them until tap water overflows from them. Then, tighten the plugs.

4) Loosen screw A at the lower part of the detector and open the upper part as shown in Figure 4.1.

5) Open V3 and feed the zero calibration water to the head tank (deaeration tank). Adjust the opening level of V3 so that the feed flow rate of the zero calibration water to the head tank may be regulated at 2 to 3 L/min. See note 3 below for how to check the flow rate.

Note 3: how to check flow rate of feed to head tank: Fully open valve V5 or SV1 below the head tank and measure the amount of discharge from the tank's drain outlet for 1 minute using a graduated measuring cylinder or beaker. Be sure to shut the valve after checking the discharge flow rate.

6) Check whether the flow rate of feed to the detector is within 1.5 to 2 L/min. If the flow rate exceeds this range, adjust it according to the procedure described in Section 4.1.5. See note 4 below for how to check the flow rate of feed to the detector.

Note 4: how to check flow rate of feed to detector: While feeding the measured water or zero calibration water to the detector, disconnect the pipe from the measured water outlet of the detector and measure the amount of discharge from the outlet for 1 minute using a graduated measuring cylinder or beaker. Be sure to connect the pipe to the detector's outlet again after checking the discharge flow rate.

Before operation, always check the flow rate of feed to the detector as above.

For a flow rate check at regular maintenance, visually check that there are no ripples on the water surface as shown in Figure 4.2 (b).

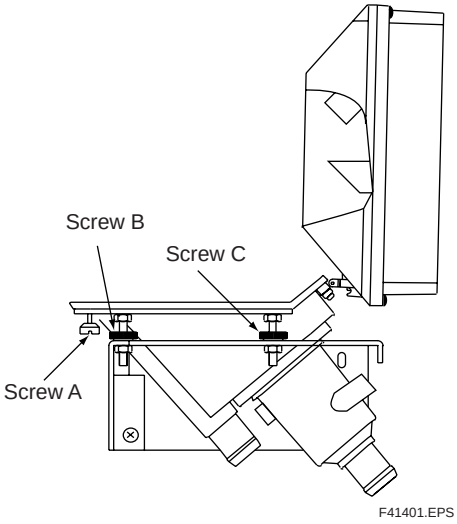

Figure 4.1 Lower Part of Detector

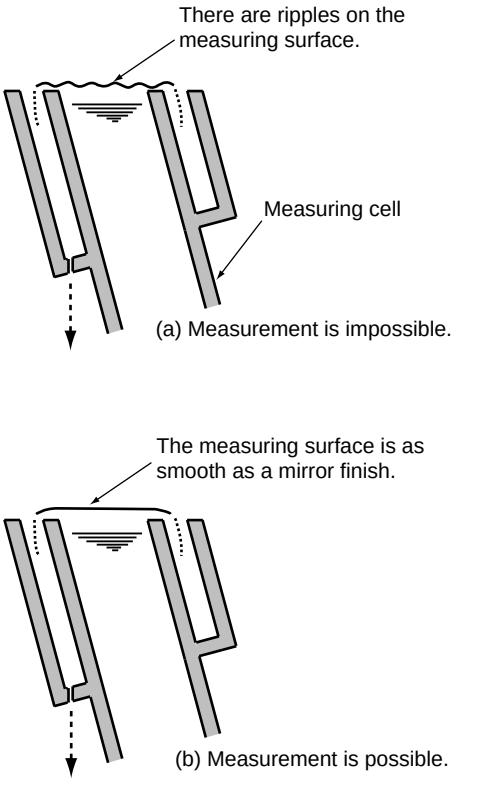
There are ripples on the measuring surface.
Measuring cell
(a) Measurement is impossible.
The measuring surface is as smooth as a mirror finish.
(b) Measurement is possible.
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Figure 4.2 Water Level of Detector

4.1.5 Adjusting Flow Rate of Feed to Detector

Flow rate adjustment has been performed for the detector at the factory before shipment. If flow rate adjustment is required as the result of checking the flow rate of feed to the detector in Section 4.1.4, carry out the follow procedure to perform adjustment.

1) Open valve V5 or SV1 below the head tank to discharge water from the head tank and detector.
2) When neither the zero calibration water nor measured water is being fed to the detector, place a level at the drain outlet of the measuring cell and adjust the level by means of the 4 adjustment screws (shown as C and B in Figure 4.1) so that the detector is level in two orthogonal directions. See Figure 4.3 for how to turn these screws.

Note 1: If a level is not available, visual adjustment is acceptable. In this case, it should be adjusted so that water spills out from the drain outlet uniformly when feeding the zero calibration water or measured water.

3) Shut valve V5 or SV1 below the head tank and feed the zero calibration water or measured water to the head tank at 2 to 3 L/min. For how to check the flow rate, see note 3 in Section 4.1.4.
4) Check whether the flow rate of feed to the detector is within 1.5 to 2 L/min. For how to check the flow rate, see note 4 in Section 4.1.4. If the flow rate exceed this range, follow the steps below to adjust the flow rate.
5) Open valve V5 or SV1 below the head tank and discharge water from the head tank and detector.
6) If the flow rate of feed to the detector's measuring cell is below 1.5 L/min, lower the detector's measuring cell by turning the 4 adjustment screws while ensuring the detector remains level.
7) If the flow rate of feed to the detector's measuring cell is beyond 2.0 L/min, raise the detector's measuring cell by turning the 4 adjustment screws while ensuring the detector remains level.
8) Repeat steps 3 to 6 above until the flow rate of feed to the detector falls within 1.5 to 2 L/min.
9) After flow rate adjustment is finished, turn the 2 screws B (left screws in Figure 4.1) by 2 rotations to lower that side, and then tighten their lock nuts when the measuring cell is in an inclined position.

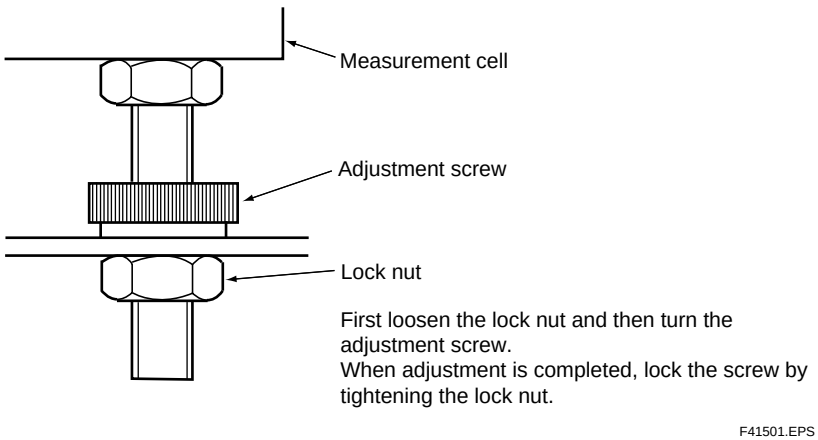
Measurement cell
Adjustment screw
Lock nut
First loosen the lock nut and then turn the adjustment screw.
When adjustment is completed, lock the screw by tightening the lock nut.
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Figure 4.3 Adjustment Screws

4.1.6 Feeding Cleaning Water

Check whether the cleaning water flow rate is adequate while zero calibration water is being fed. This procedure is unnecessary when the cleaning water is not connected to the detector.

1) Using the [SV2] key of the converter, open cleaning water valve SV2.

Note 1: If the automatic cleaning function is not used, SV2 does not exist.

2) Gradually open V4 and feed the cleaning water at a rate that does not allow water to splash out of the detector's measuring cell.

3) Shut SV2.

Note 2: If the automatic cleaning function is not used, leave V4 shut.

4) Shut the detector and tighten screw A (see Figure 4.1) to fix the upper part.

Note 3: If the automatic cleaning function is not used, manually open and shut V4 whenever performing cleaning.

4.1.7 Setting Output Range

Set the analog output range selection (local / remote) and the range. (When shipped from the factory, this is set to local range selection and to RANGE1 (0 to 10 NTU).) For output range setting, see Section 5.2.

4.1.8 Running-in

Carry out running-in for an hour or more while allowing " zero water " to flow.

4.1.9 Zero and Span Calibrations

After the indication is stable, zero calibration and span calibration is made in use of zero water and calibration plate respectively.

First, carry out zero calibration.

1. Set FUNCTION " 1 " in the < MAINT. > mode. ⇒ " Turbidity value " is displayed.
2. Wait for the indication to stabilize, and then press [ENT] ⇒ [>] ⇒ [ENT] keys in this order to carry out zero calibration.

Next, carry out span calibration.

1. Set FUNCTION " D. " in the < PROGRAM1 > mode and confirm that " on " is displayed. " on " means the calibration using the calibration plate (" on " is set when shipped from the factory).
2. Set FUNCTION " 4 " in the < MAINT. > mode. ⇒ " Turbidity value " is displayed.
3. Set to the drain status.
   - Close V2 and open V5 (for with sampling system shown in section 2.8.1).
   - Close V2 and open SV1 (with sampling system and auto cleaning shown in section 2.8.2).
   - Close SV4 and open SV1 (with sampling system and auto cleaning, auto zero calihration shown in section 2.8.3).

4. Loosen screw A at the lower part of the detector to open the detector (see Figure 4.1).

5. Set the attached calibration plate as shown in Figure 4.4 .

6. Close the detector and tighten screw A.

7. Wait for the indication to stabilize and press [ENT] ⇒ [>] ⇒ [ENT] to calibrate.

8. Open the detector and remove the calibration plate and then tighten screw A.

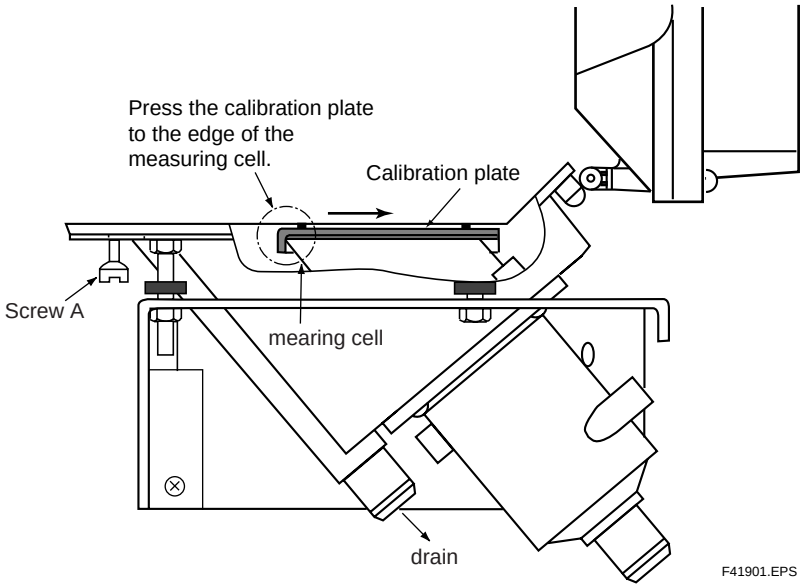

Figure 4.4 Calibration Plate Setting

4.1.10 Feeding Measured Water and Adjusting Measured Water Flow Rate

1) Press the [MODE] key to change the mode to <MEAS.>.

2) Set up the hand-operated valves to the measurement positions (see Table 4.1 in Section 4.2).

Note 1: SV1 to SV4 are automatically set up to the measurement positions when the mode is set to <MEAS.>.

3) Open V1 and feed the measured water to the head tank (deaeration tank). Adjust the opening level of V1 so that the measured water is fed to the head tank at 2 L/min or greater.

Note 2: For how to check the flow rate of feed to the head tank, see note 3 in Section 4.1.4.

4) Check whether the flow rate of feed to the detector is within 1.5 to 2 L/min. If the flow rate exceeds this range, adjust it according to the procedure described in Section 4.1.5.

Note 3: See note 4 in Section 4.1.4 for how to check the flow rate of feed to the detector.

4.2 Operation

This section describes measurement in the < MEAS. > mode, the on / off operation of each valve in automatic cleaning and automatic zero calibration, and the settings related to operation. Refer to 2.8 Example Piping System Diagrams for each valve's operation.

The actions of the valves are described in reference with piping diagrams shown in Section 2.8.

4.2.1 Starting Measurement

When the [MODE] key in the converter is pressed to move to the < MEAS. > mode, the internal timer starts and analog output hold (set when shipped from the factory) is reset according to the predetermined specifications.

The maintenance contact outputs (M1 and M2) also become open (set when shipped from the factory) and the mode information is output only once to the digital output (see the contact output operation in Subsection 3.3.8 and digital communication specifications in Section 2.1).

Table 4.1 shows the valve statuses in the < MEAS. > mode. Valves SV1 to SV4 automatically operate according to the predetermined specifications. The statuses shown in Table 4.1 are those when no automatic cleaning or automatic zero calibration operates.

Table 4.1 Valve Statuses When Measurement Is Carried Out

Configuration	Diagram of Recommended Piping	V1	V2	V3	V4	V5	SV1	SV2	SV3	SV4
With sampling system	See Section 2.8.1	Open	Closed	Closed	Closed	Closed	—	—	—	—
With sampling system and automatic cleaning system	See Section 2.8.2	Open	Open	Closed	Open	—	Closed	Closed	—	—
With sampling system, automaticcieaning and automatic zero calibration system	See Section 2.8.3	Open	Open	Open	Open	—	Closed	Closed	Open	Closed

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4.2.2 Automatic Cleaning Operation

When automatic cleaning is added, the detector is automatically cleaned in the < MEAS. > mode. With measuring water (or zero water) flowing, dirty substances on the measuring cell wall and the measuring surface edge are washed out by spouting cleaning water (tap water) out of two outlets on the side of the measuring cell in the detector. After cleaning, dirt on the measuring cell, deforming tank, and in the piping between the deforming tank and the detector is washed out by opening the drain outlet of the deforming tank.

The above cleaning operation is repeated a predetermined number of times.

The information of start or end is output to the output when automatic cleaning is started or ended. Refer to 2.1 Digital Communication Specifications.

In addition, there are two types depending on the specifications for automatic cleaning.

- With automatic cleaning
- With automatic cleaning ,and automatic zero calibration

  Note: This function is available when parameters of sampling function on the converter is specified for the system with automatic cleaning function or automatic zero calibration.

The explanation for each types are followed.

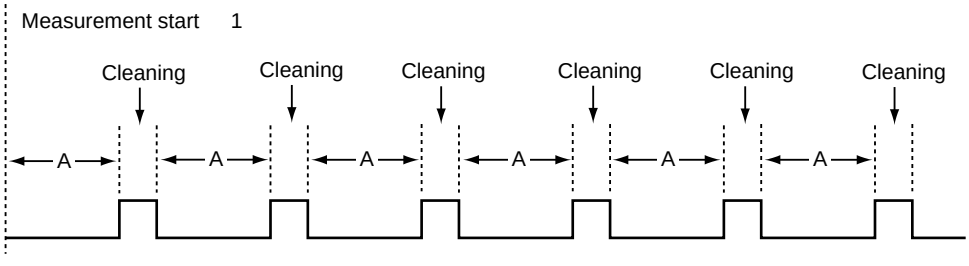
a. With Automatic Cleaning (refer to 2.8.2 Piping Diagrams)

Automatic cleaning can be started in the following two ways:

- Startup with the internal timer
- Startup with FUNCTION " 6 " in the < MAINT.> mode (see Section 6.5).

  Note: Startup with the internal timer can be selected for execution (on) / stop (off) using FUNCTION " A. " in the < PROGRAM1 > mode. It has been set to execution (on) when shipped from the factory.

The internal timer operation is shown below. The automatic-cleaning operation is repeated at every preset time of the cleaning period (A) (Figure 4.5).



1 Measurenent start is define to be the point specifid in the following :
Other mode → <MEAS.> @mode
powee off → Power on (<MEAS.> mode)

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(*1) Measurement start is defined to be the point specified in the following:

Figure 4.5 Cleaning Period

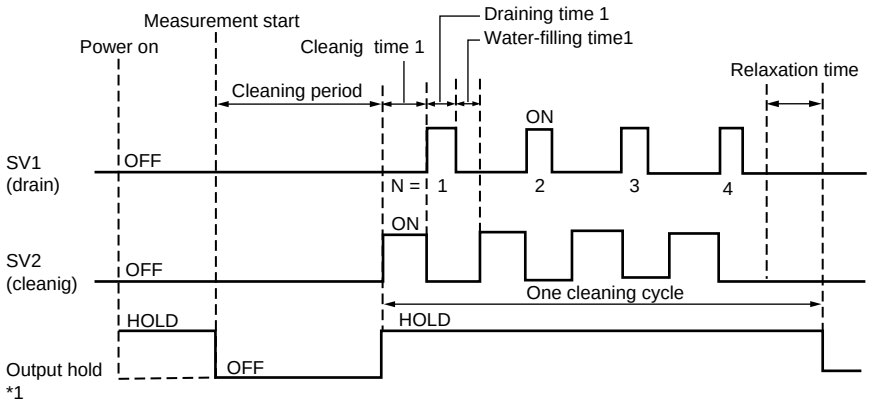
Figure 4.6 shows the automatic-cleaning operation time chart and Table 4.2 the list of settings for automatic cleaning.

< Valves used >

SV1: Drain valve

SV2: Cleaning water valve

< Time chart > (Ex.) N (number of cleaning repetitions) = 4



(*1) During cleaning, the output is always in the hold state.
The display is also set to be held using FUNCTION " 8. " in the < PROGRAM1 > mode.
Contact outputs C1 and C2 can be used as contacts for the period during cleaning and calibration. This is set using FUNCTION " E. " in the <PROGRAM1> mode.

Note 1 N:Number of cleaning repeats
Note 2 One automatic cleaning cycle = N (cleaning + draining + water filling) + relaxation

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Figure 4.6 Automatic-cleaning Operation Time Chart

Table 4.2 Cleaning Operation Setpoints

Item	Range that can be set	Setting when shipped from the factory	Unit	Setting mode	
				Mode	FUNCTION
Cleaning period	0.1 to 24.0	2.0	Hours	PROGRAM2	1
Cleaning time 1	10 to 120	30	Sec	PROGRAM2	4
Draining time 1	10 to 120	10	Sec	PROGRAM2	6
Water filling time 1	10 to 120	100	Sec	PROGRAM2	8
Relaxation time	30 to 600	150	Sec	PROGRAM2	A
Number of cleaning repetitions	1 to 20	5	times	PROGRAM2	3

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See Section 6.7 for the setting procedures for each setpoint.

b. With Automatic Cleaning and Automatic Zero Calibration (refer to 2.8.3 Piping Diagrams).

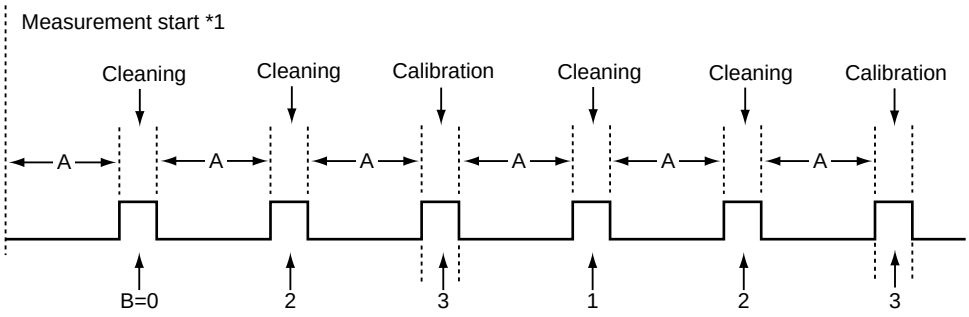
Automatic cleaning can be started in the following two ways:

- Startup with the internal timer
- Startup with FUNCTION " 6 " in the < MAINT. > mode (see Section 6.5).

Note: Startup with the internal timer can be selected for execution (on) / stop (off) using FUNCTION " A " in the < PROGRAM1 > mode. It has been set to execution (on) when shipped from the factory.

The internal timer operation is shown in Figure 4.7.

As shown in the figure, the automatic cleaning operation is repeated at every set time of the cleaning period (A) and automatic zero calibration is implemented once in every 3 repetitions (for cleaning calibration ratio B = 3).



(*1) Measurement start is defined to be the point specified in the following:
Other mode ⟶ < MEAS. > mode
Power off ⟶ Power on (< MEAS. > mode)

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Figure 4.7 Cleaning (Calibration) Period (Ex: for cleaning calibration ratio = 3)

However, if startup of the automatic zero calibration with the internal timer is stopped, the cleaning operation becomes the same as in Figure 4.5 because the automatic zero-calibration operation is eliminated.

Figure 4.8 shows the automatic-cleaning operation time chart and Table 4.3 the settings.

< Valves used >

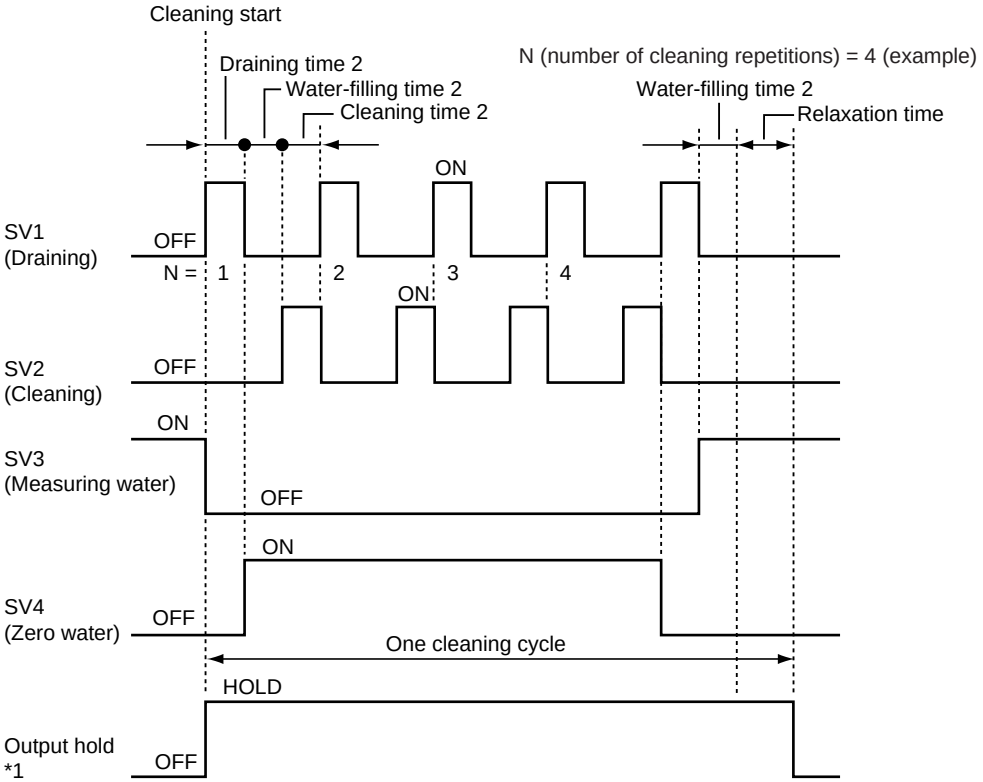
SV1: Drain valve

SV2: Cleaning-water valve

SV3: Measuring-water valve

SV4: “ Zero-water ” valve

< Time chart >



(*1) During cleaning, the output is always in hold state.
The display is also set to be held using FUNCTION " 8 " in the < PROGRAM1 > mode.
Contact outputs C1 and C2 can be used as contacts for the period during cleaning and calibration. This is set using FUNCTION " E " in the < PROGRAM1 > mode.

(Note 1) N: Number of cleaning repetitions
(Note 2) One automatic cleaning cycle = N (draining + filling + cleaning) + (draining + filling + relaxation)

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Figure 4.8 Automatic-cleaning Operation Time Chart

Table 4.3 Setpoints for Automatic Cleaning and Automatic Zero Calibration

Item	Range that can be set	Setting when shipped from the factory	Unit	Setting mode	
				Mode	FUNCTION
Cleaning period	0.1 to 24.0	2.0	Hours	PROGRAM 2	1
Cleaning calibration ratio	1 to 10	1	times	PROGRAM 2	2
Cleaning time 2	10 to 120	30	second	PROGRAM 2	5
Draining time 2	10 to 120	10	second	PROGRAM 2	7
Water-filling time 2	10 to 120	100	second	PROGRAM 2	9
Relaxation time	30 to 600	150	second	PROGRAM 2	A
Number of cleaning repetitions	1 to 20	5	times	PROGRAM 2	3

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For the setting procedures for each setpoint, see Section 6.7.

4.2.3 Automatic Zero-calibration Operation

If the automatic zero calibration is added, zero calibration is automatically performed. The automatic zero-calibration computation is implemented by passing zero water and at a stabilized indication after performing the same cleaning operation as automatic cleaning in subsection 4.2.2 b.

In addition, at the start and end of automatic zero calibration, all starting and completing digital information is output (see digital communication specifications in Section 2.1).

Automatic zero calibration can be started in the following two ways:

- Startup with the internal timer (see Figure 4.7).
- Startup with FUNCTION " 7 " in the < MAINT. > mode (see Section 6.5).

Note: Startup with the internal timer can be selected for execution (on) / stop (off) using FUNCTION " B. " in the < PROGRAM1 > mode. It has been set to execution (on) when shipped from the factory.

Figure 4.9 shows the automatic zero-calibration operation time chart.

For the setting, see Table 4.3.

< Valves used >

SV1: Drain valve

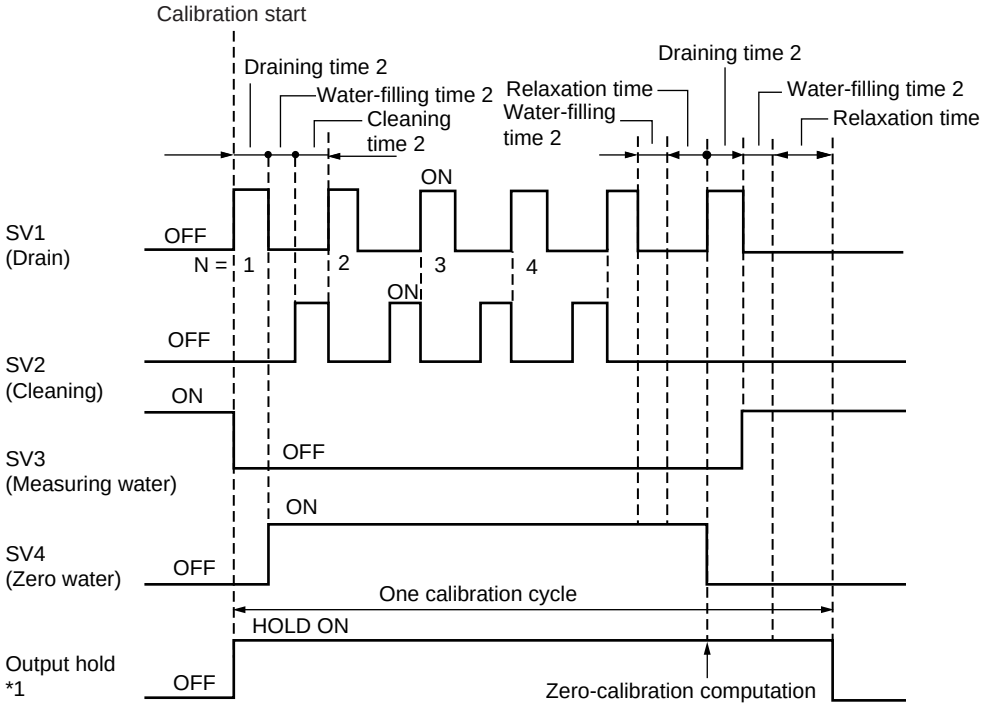
SV2: Cleaning-water valve

SV3: Measuring-water valve

SV4: " Zero-water " valve

Note : This function is available when parameters of sampling function on the converter is specified for the system with automatic cleaning function or automatic zero calibration.

< Time chart > N (number of cleaning repetitions) = 4 (Example)



(*1) During calibration, the output is always in the hold state.
The display is also set to be held using FUNCTION " 8 " in the < PROGRAM1 > mode.
Contact outputs C1 and C2 can be used as contacts for the period during cleaning and calibration.
This can be set using FUNCTION " E " in the < PROGRAM1 > mode.

Note 1 N : Number of cleaning repetitions
Note 2 One automatic zero calibration cycle = N (draining + filling + cleaning) + 2 (draining + filling + relaxation)

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Figure 4.9 Automatic Zero-calibration Time Chart

5. FUNCTIONS

This chapter describes the functions of the converter. For each function, the relevant items are arranged. For the setting procedures, see Chapter 6, the operation procedure for each FUNCTION in each mode.

5.1 Functions Related to Failure Detection

Table 5.1 shows the failure detection functions.

Table 5.1 Failure Detection Function (first page of 2 pages)

Detected item	Details	Generation mode	Error No.	FAIL lamp	Detection on / off setting	
					Mode	FUNCTION
(1) Turbidity overrange	This is detected if the measurement signal from the detector is out of the permissible range. The permissible range is approx. +0.5V to - 2.45 V across S1 and AG terminals in the converter.	MEAS.	Err11	○	PROGRAM2	1.
(2) Lamp disconnection	This is detected if the lamp goes off and the reference signal drops to approximately - 0.5 V or less.	MEAS.	Err12	○	PROGRAM2	2.
(3) Lamp voltage failure	This is detected if the lamp voltage is out of the permissible range. The permissible range is approximately 3 V to 6.5 V across terminals P1 and P2 in the converter.	MEAS.	Err13	○	PROGRAM2	3.
(4) AD circuit failure	1. Detected if analog-to-digital conversion is not completed in the predetermined time. 2. If the converted data are out of the permissible range, this is detected if the input is switched to a simulated input and the converted data are again out of range.	All modes	Err14	○	PROGRAM2	4.
(5) Memory comparison failure	Data such as setpoints are stored in two places in the EEPROM. This is detected if the results of regular comparisons of such data do not agree.	All modes	Err15	○	PROGRAM2	5.
(6) RAM failure	Detected if the result of a comparison of specified data in writing and reading immediately after turning on power does not agree. If detected, subsequent operations cannot be accepted.	When power is turned on	Err16	○		
(7) EEPROM failure	Immediately after turning on power, the data stored in two places in the EEPROM are compare. If they do not agree, this item is detected if the result of the comparison of specified data in writing and reading does not agree. If detected, subsequent operations cannot be accepted.	When power is turned on	Err17	○		
(8) Reference signal voltage failure	If the reference signal from the detector is out of the permissible range, this item is detected. The permissible range is approximately + 0.5 V to - 2.45 V across terminals S2 and AG.	MEAS.	Err18	○	PROGRAM2	6.
(9) Zero-calibration range exceeded	Detected when the input value in zero calibration is out of the permissible range. The permissible range is ±100 mV.	When calibration is carried out	Err21	×		

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Table 5.1 Failure Detection Function (second page of 2 pages)

Detected item	Details	Generation mode	Error No.	FAIL lamp	Detection on / off setting	
					Mode	FUNCTION
(10) Span calibration range exceeded	Detected if the input value in span calibration is out of the permissible range. For span calibration (standard solution reference), the permissible range is 50 to 400%. For span calibration (sensitivity correction), the permissible range is 0.25 to 4.00. For details, see section 5.3 (*3).	When calibration is carried out	Err22	×		
(11) Zero-shift calibration range exceeded	Detected if the zero-correction coefficient in zero-shift calibration is out of the permissible range. The permissible range is ± 9 NTU.	When calibration is carried out	Err23	×		
(12) Calibration plate failure	Detected if the input value in span calibration is out of the permissible range. The permissible range is ± 50 % of the calibration plate setpoint.	When calibration is carried out	Err24	×		
(13) Lamp life *1	Detected if the lamp voltage reaches the upper control limit. The upper limit is approx. 5.4 V across terminals P1 and P2.	MEAS.	Err25	○	PROGRAM2	7.
(14) Failure in automatic zero calibration *2	Detected if the zero input value in automatic zero calibration is out of the permissible range. The permissible range is ± 100 mV	MEAS.	Err26	○	PROGRAM2	8.
(15) Upper and lower limit alarm *3	Detected if the turbidity signal exceeds the upper or lower limit setpoint. When shipped from the factory, these are set at - 10 (lower) and 2200 (upper) NTU.	MEAS.	" MEAS. " flashes.	×	PROGRAM2	9.
(16) CPU failure	CPU failure. Normally this does not occur.	All modes	Only the " FAIL " lamp is lit and no operations are accepted.			

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- In the " FAIL lamp " column, O means the lamp lights and X the lamp goes out.
- The items for detected failures for which both the mode and function are described can be selected for execution/stop of detection (see Section 6.7).
- Errors detected other than in calibration are automatically reset at the time when the cause of a failure is removed.
- If the " FAIL " lamp is lit, error numbers can be confirmed with FUNCTION " A " in the < MAINT. > mode, while the error can be reset with FUNCTION " B " in the < MAINT. > mode.
- If the " FAIL " lamp is lit, analog output mode selection (non-hold, hold, or preset) is possible with FUNCTION " 5 " in the < PROGRAM1 > mode.
- If the " FAIL " lamp is lit, FAIL contact output is also obtained.
- If an Err11 to 15, Err18, Err25, or Err26 failure is detected, error numbers are output by virtue of digital output (see Section 2.1, digital communication specifications).
- If Err16 or Err17 is detected, other operations cannot be accepted with the error number displayed.

(*1) The TB450G controls the lamp voltage so that a constant light quantity is obtained. If the amount of lamplight diminishes, the lamp voltage increases. Thus, the lamp voltage may be an index for the life of the lamp.

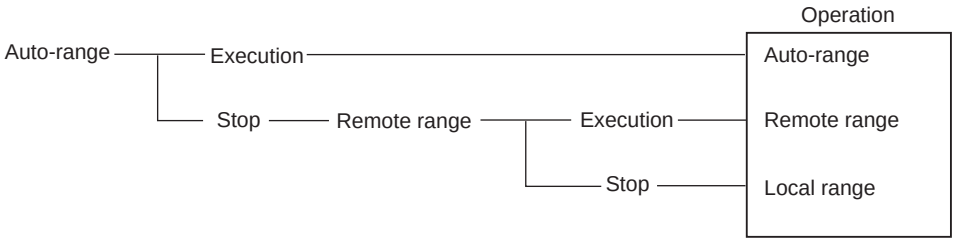
(*2) Err26 is detected only if the specifications are for automatic zero-calibration.

(*3) 15. upper and lower limit alarm setpoints can be set using FUNCTION “ 8 ” and “ 9 ” in the < PROGRAM1 > mode.

5.2 Functions Related to Analog Output

5.2.1 Output Range Selection

The output range can be selected among three ranges: auto range, remote range, and local range. The relationship between these is as shown in Figure 5.1. Table 5.2 shows the setting modes and function numbers related to the output range selection.



(Note) The turbidimeter is shipped with the output range set to 1 for the local range.

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Figure 5.1 Output Range Selection

Table 5.2 Function Related to Output Range Selection

Detected item	Details	Mode	FUNCTION
(1) Output range 1 setting	The upper and lower limits for analog output 1 are set.	PROGRAM1	1
(2) Output range 2 setting	The upper and lower limits for analog output 2 are set.	PROGRAM1	2
(3) Output range 3 setting	The upper and lower limits for analog output 3 are set.	PROGRAM1	3
(4) Auto-range selection	The function that automatically switches the output ranges (1, 2, and 3) depending on the turbidity value.	PROGRAM1	1.
(5) Remote range selection	The function that switches the output ranges (1, 2, and 3) by contact inputs (R1, R2, and R3) (when function (4) is " OFF ").	PROGRAM1	2.
(6) Local range selection	The function that switches the output ranges (1, 2, and 3) using converter key operations (when functions (4) and (5) are " OFF ").	PROGRAM1	3.
(7) Auto-range switching point setting	The auto-range switching point is arbitrarily set when auto-range is used.	PROGRAM1	7

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- Corresponding to switching of the output range, the range contact outputs (A1, A2, A3, A4) are switched and the RNG1, RNG2, or RNG3 lamp is lit.

  1) Output range 1: Range contact outputs A1 and A2 are closed ; RNG1 lamp is lit.

  2) Output range 2: Range contact outputs A1 and A3 are closed; RNG2 lamp is lit.

  3) Output range 3: Range contact outputs A1 and A4 are closed; RNG3 lamp is lit.

- When the output range is switched, digital range information is output only once (see Section 2.1, “ Digital Communication Specifications ”).

- When the turbidimeter is used with auto-range, the output should be set as shown below.

  1) Set the Low side of the setting to 0 (display is “ L00.00 ”).

  2) Set the High side of the setting so that range 1 ≦ range 2 ≦ range 3 holds.

  3) If two ranges are required, set range 2 = range 3.

  4) If one range is required, set range 1 = range 2 = range 3.

● Range switching timing in auto-range should be taken as follows:

1) The timing of switching from a lower range to a higher range is a point where the measured value just becomes larger than the auto-range switching point of the lower range.

2) The timing of switching from a higher range to a lower range is a point where the measured value just becomes smaller than - 10% of the auto-range switching point in the lower range (10% is provided for range switching hysteresis).

Note : Auto-range switching should be set in item (7). When the turbidimeter is shipped from the factory, this is set to 80% of the range.

● In auto-range, the output ranges are switched for contact inputs (R1, R2, and R3).

1) No contact input: Output range 1

2) Contact input (R1, R2) = Closed: Output range 2

3) Contact inputs (R1, R3) = Closed : Output range 3

5.2.2 Other Functions Related to Output

Table 5.3 shows other functions related to analog output and the operation modes and function numbers for setting.

Table 5.3 Other Functions Related to Output

Function	Description	Mode	FUNCTION
(1) Line-segment approximation output	Setting of break points when an analog signal is output with line-segment approximation.	PROGRAM1	6
(2) Output hold during maintenance	When maintained (other than the < MEAS. > mode), the function to hold the analog output.	PROGRAM1	4.
(3) Output mode when a failure is detected	Analog output mode (non-hold, hold, or preset) selection when the " FAIL " lamp is lit	PROGRAM1	5.
(4) Holding an output of 4 mA or less	If a turbidity value becomes smaller than the output range lower limit, the output is held at 4 mA (1 V).	PROGRAM1	6.
(5) Setting of output value if a failure is detected.	If " preset " is selected in function (3) , the value set here is output.	PROGRAM1	5

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(1) Line-segment Approximation Output

The point where a setpoint (%) of the output range span (NTU) corresponds to 50% of the output signal (4 to 20 mA or 1 to 5 V) span is the break point. The setting range is O to 100%. Figure 5.2 shows an example of a setting.

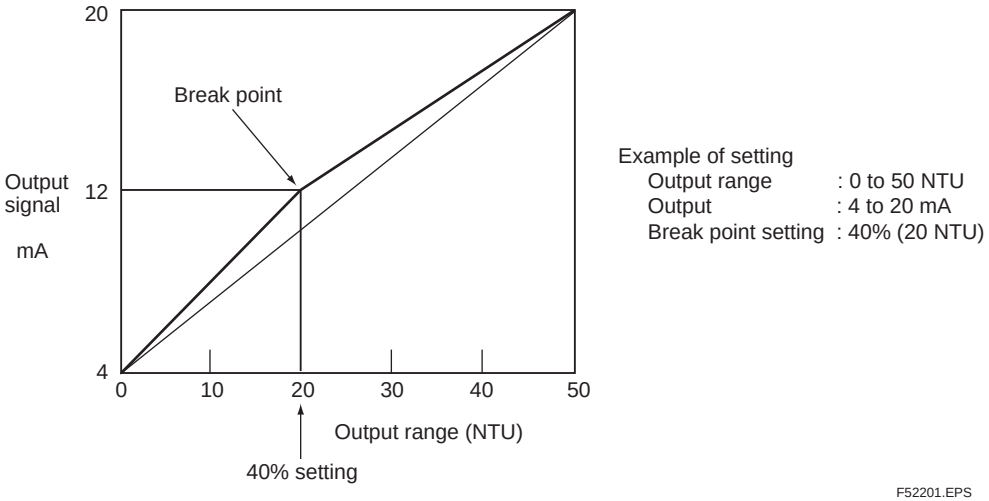

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Figure 5.2 Example of Line-segment Approximation Output

If the output range setpoint is determined to be 50%, the output is linear. at 0 % or 100 %, the output is as shown in Figure 5.3 respectively.

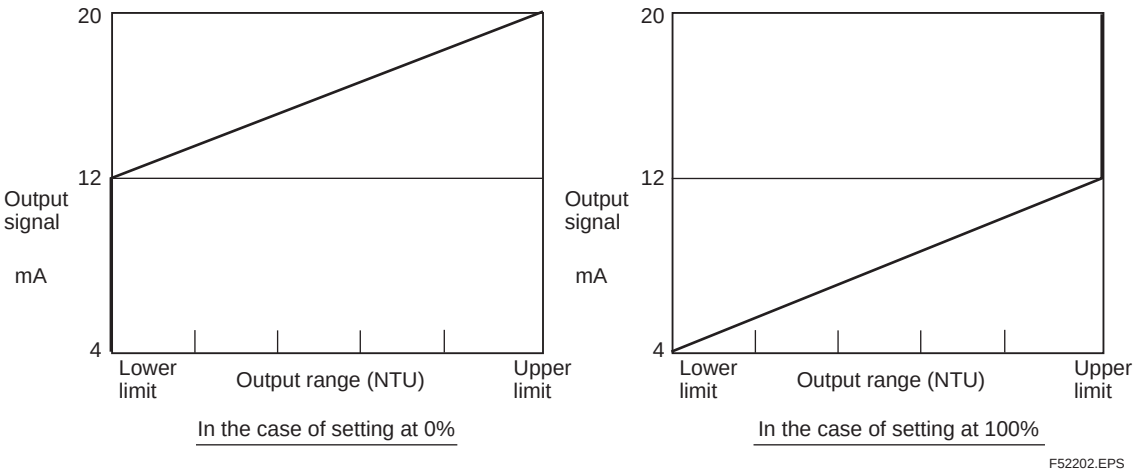

Figure 5.3 Output When the Break Point is set at 0% and 100% of the Output Range

5.3 Manual Cleaning and Calibration Functions

Table 5.4 shows a list of manual cleaning and calibration functions. For operation and setting procedures, see the procedures for each mode and the functions in Chapter 6.

Table 5.4 Manual Cleaning and Calibration Functions

Function	Description	Mode	FUNCTION
(1) Zero calibration (zero water)	Zero-point calibration using zero water	MAINT.	1
(2) Zero calibration (lamp OFF) *1	Zero-point calibration with the lamp turned off When the measurement is over 200 NTU turbidity, zero calibration can be made at Ramp off.	MAINT.	2
(3) Zero-shift calibration *3	A function to make the zero point agree with the desired value.	MAINT.	3
(4) Span calibration (calibration plate/standard solution)	Span calibration using the calibration plate and standard solution. The calibration plate and standard solution should be selected according to function	MAINT.	4
(5) Span calibration (sensitivity correction) *3	A function to make the point at the upper end of the span agree with the desired value	MAINT.	5
(6) Manual start of automatic cleaning *2	Cleaning operation can be started in the < MAINT. > mode	MAINT.	6
(7) Manual start of automatic calibration *2	Calibration operation can be started in the < MAINT. > mode.	MAINT.	7
(8) Reference sensitivity calibration	Reference span calibration carried out with standard solution upon shipment from the factory. This sensitivity becomes the reference of the slope display and slope failure assessment. Normally, this is not used except upon shipment from the factory.	MAINT.	8
(9) Lamp control reference value	The converter lamp voltage is fixed at 4.9 V and the reference signal voltage at that time is stored as the reference. The lamp voltage is controlled by this reference value.	MAINT.	C
(10) Setting of calibration plate turbidity value	The calibration plate turbidity value is set (marked at the rear of the calibration plate).	PROGRAM1	A
(11) Setting of zero correction factors	The zero correction factor obtained in item (3) can be displayed and changed.	PROGRAM1	B
(12) Setting of sensitivity correction factor	The sensitivity correction factor obtained in item (5) can be displayed and changed.	PROGRAM1	C
(13) Selection of calibration plate/standard solution	Which span reference is used, either the calibration plate or the standard solution, for span calibration in item (4), is selected.	PROGRAM1	D.

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(*1) (*1) The difference in the zero point between the procedures using “ zero water ” and the lamp being off is approximately 1 NTU or less.

(*2) For the automatic cleaning operation in the < MEAS. > mode, see subsection 4.2.2. For the automatic calibration operation in the < MEAS. > mode, see subsection 4.2.3.

(*3) Normal zero and span calibration is carried out using items (1) or (2) and (4) of Table 5.4 taking the standard solution as the reference (equation 5.1). However, if the indications are to agree with the arbitrary values using a solution other than the standard solution as the reference, calibration with item (3) and (5) of Table 5.4 is carried out. In this case, the zero correction factor and sensitivity correction factor is used separately from the zero and spans calibration coefficients for calibration referencing to the standard solution (see equation 5.2).

$$T1 = S (V - A) \quad \text{..... Eq. 5.1}$$

$$T2 = K (T1 + B) \quad \text{..... Eq. 5.2}$$

where,

T1: Turbidity value using standard solution as the reference

S: Span calibration coefficient (referencing to standard solution) This is calculated when calibrating item (4) in Table 5.4, and the ratio of the span calibration coefficient (S0) calculated by reference sensitivity calibration in item (8) in Table 5.4 (normally implemented upon shipment from the factory) to this coefficient, S0 / S, is displayed as the slope in item (8). The permissible range for item (4) in Table 5.4 is $50\% \leqq S0 / S \leqq 400\%$.

A: Zero-calibration coefficient (referencing to standard solution) This is calculated in calibration for items (1) and (2) in Table 5.4 and the turbidity-converted value of this coefficient (S X A) is displayed as a zero-point error because of item (7) in Table 5.5.

$-100\text{mV} \leqq A \leqq 100\text{ mV}$ is the permissible range of items (1) and (2) in Table 5.4.

V: Measuring signal, a voltage signal from the detector

T2: Turbidity value after correction

K: Sensitivity correction factor

This is calculated in the calibration of item (5) in Table 5.4, and can be displayed and changed using item (12) in Table 5.4.

The permissible range in items (5) and (12) in Table 5.4 is $0.25 \leqq K \leqq 4.00$.

B: Zero-correction coefficient

This is calculated in item (3) in Table 5.4 and can be displayed and changed using item (11) in Table 5.4.

$-9\text{ NTU} \leqq B \leqq 9\text{ NTU}$ is the permissible range for items (3) and (11) in Table 5.4.

(Note 1) Turbidity in the < MEAS. > mode is displayed in T2 (turbidity after correction). However, when the turbidimeter is shipped from the factory, the zero and sensitivity correction factors are 0.0 NTU and 1, respectively. Thus, T1 = T2.

(Note 2) For zero and span calibration of (1), (2), (4), and (8) referencing the standard solution, T1 (turbidity before correction) is always displayed as turbidity.

5.4 Functions Related to Display

In the < MEAS. > mode, each item in Table 5.5 can be selectively displayed. In addition, Table 5.6 shows the functions related to turbidity display.

Table 5.5 Functions Related to Display

Function	Description	Mode	FUNCTION
(1) Turbidity display *1	Turbidity is displayed.	MEAS.	1
(2) Lamp voltage display	The lamp voltage in the converter is displayed. * 1	MEAS.	2
(3) Measured signal current display	The measured value by the receiving element that measures scattered light is displayed in the current value.	MEAS.	3
(4) Reference signal voltage display	The signal of the receiving element that controls the lamp light quantity is displayed in the voltage value.	MEAS.	4
(5) Analog output % display	The analog output is displayed after being converted into % FS.	MEAS.	5
(6) Analog outputmA display	The analog output is displayed after being converted into 4 to 20 mA.	MEAS.	6
(7) Zero error display *1	The measured signal in zero calibration does not become 0 mV exactly. This error (mV) is displayed after being converted to turbidity.	MEAS.	7
(8) Slope display	Sensitivity at the latest span calibration to the sensitivity at reference sensitivity calibration is displayed in %.	MEAS.	8

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Table 5.6 Functions Related to Turbidity Display

Function	Description	Mode	FUNCTION
(1) Negative turbidity display hold *2	If the value of the turbidity is negative, the turbidity is fixed at 0.00 NTU.	PROGRAM1	7.
(2) Display hold in automatic cleaning or zero calibration	The display in the automatic cleaning or zero calibration is fixed.	PROGRAM1	8.
(3) Selection of turbidity unit indication	The unit of turbidity indication (NTU, mg/l, and degree) can be selected.	PROGRAM1	C.

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(*1) Owing to item (3). in Table 5.6, the unit indication can be changed.

(*2) Even if this function is on, a negative value is displayed in other than the < MEAS. > mode.

5.5 Functions Related to Contact Output

An on or off operation can be selected for every contact output. The output AUX (C1, C2) is used for either upper and lower limit alarm output or automatic cleaning and calibration output.

Table 5.7 Functions Related to Contact Output

Function	Description	Contact	Mode	FUNCTION
Selection of maintenance contact output open or close	Open or closed (set upon shipment from the factory)	M1, M2	PROGRAM2	C
Selection of FAIL contact output open or close	Open (set upon shipment from the factory) or closed	F1, F2	PROGRAM2	D
Selection of upper and lower limit alarm output open or close	Open (set upon shipment from the factory) or closed	C1, C2	PROGRAM2	E
Selection of automatic cleaning or zero calibration output open or close	Open or closed (upon shipment from the factory)	C1, C2	PROGRAM2	F
Selection of C1 and C2 outputs	Selection of upper and lower limit alarm output or automatic cleaning or calibration output	C1, C2	PROGRAM1	E.

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5.6 Other Functions

Table 5.8 shows other functions.

Table 5.8 Other Functions

Function	Description	Mode	FUNCTION
Converter checks	It can be confirmed that the converter operates normally.	MAINT.	9
Setting of turbidity signal average factor	Setting of the average factor of turbidity indication analog output	PROGRAM1	4

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5.6.1 Overview of the Option “ Bubble Retardant ”

Normally, the turbidity indication changes to the positive side drastically like a step-pulse waveform if air bubbles or dust arise on the light-scattering surface of the detector’s measuring tank. The amount of such a sudden change is in no way uniform and depends on the size of air bubbles or dust and their behavior on the light-scattering surface.

The TB450G NTU-compliant surface-scattered type turbidimeter can be equipped with a header tank for eliminating air bubbles. This tank removes air bubbles such that they do not reach the detector. In some cases, air bubbles that grow in the piping between the header tank and the detector rise to the light-scattering surface and drastically change the reading, though this is quite rare.

The converter has a function for averaging turbidity signals, where the degree of averaging can be varied as necessary. It is therefore possible to counter small changes in the reading due to air bubbles or dust particles to some degree by increasing the averaging factor.

Making the averaging factor too large however, will cause a proportional delay in the response of turbidity signals. It is therefore not practical to set too large an averaging factor and we needed to find a means of detecting the change in readings solely due to air bubbles or dust particles that would not produce a change on the display or in the output signal.

Notes on Use

The “ Bubble Retardant ” option is effective for regular processes where the change in turbidity is comparatively small; it may not be suitable for processes where turbidity changes drastically. Even though there is no drastic change in turbidity, the turbidity indication may sometimes change like a step pulse. If this is the case, this option may cause a delay in the turbidity indication or output response. When using the option, give full consideration to your process conditions and adjust the option’s setpoint, little by little, so that it befits the operating conditions.

Explanation of operation

The “ Bubble Retardant ” is used by following procedure.

1) Checks the input turbidity signal before averaging.
2) Calculates the difference between the current input signal level and the preceding input signal level.
3) Compares the difference to the “ detection level. ”
4) Performs the normal averaging calculation and updates the turbidity indication and output if the difference is smaller than the “ detection level. ”
5) Holds the turbidity indication and output for the “ holding time ” if the difference is greater than the “ detection level. ”
6) Does not perform the “ detection level ” check during the holding period.
7) Does not perform the “ detection level ” check but performs the averaging calculation and updates the turbidity indication and output, for the “ sample time ” after the holding time has passed.
8) Starts performing “ detection level ” check again after the “ sample time ” has passed.

Notes on Use

The “ Bubble Retardant ” option is effective for regular processes where the change in turbidity is comparatively small; it may not be suitable for processes where turbidity changes drastically. Even though there is no drastic change in turbidity, the turbidity indication may sometimes change like a step pulse. If this is the case, this option may cause a delay in the turbidity indication or output response. When using the option, give full consideration to your process conditions and adjust the option’s setpoint, little by little, so that it befits the operating conditions. In conclusion, take note of the following when using the option.

1) Adjust the detection level according to the degree of change in the reading due to air bubbles or dust.
2) Do not set the hold time at too large a value, as the turbidimeter may fail to measure the change in turbidity indication, which is its primary purpose.
3) If the option is responsible for the delay in the response of the turbidity indication, try setting a relatively longer sampling time without changing the hold time.
4) If the turbidity reading seems to be abnormal, temporarily turn off the option and wait for a while to see how the state changes. This is because the primary trends of turbidity readings are often masked if the option is active.

5.6.2 Settings for Executing the " Bubble Retardant " Option

To actuate this option, set necessary data in the PROGRAM1 mode by following the procedure given below.

Select from the two options, i.e., " Enable (ON) " (FUNCTION " F. ")."

Set the detection level (FUNCTION " D ").

Set the hold time (FUNCTION " E ").

Set the sampling time (FUNCTION " F ").

a. Detection Level (%)

The detection level is a reference value used to check whether the difference between the level of a pre-averaging turbidity signal and the last-acquired signal level, is larger or smaller than the value previously set in the converter. The detection level is defined as the percent of the upper limit of the analog output range that is currently selected. The percent setpoint is then converted by the computer to a value equivalent to the turbidity signal level. (The ratio of the sensitivity correction factor is also calculated automatically.)

The regular indication and output of turbidity are post-averaging values. Consequently, the general rule for setting a value for this data item (the detection level) is to consider the dispersion among the levels of the detector's pre-averaging turbidity signal and set a value greater than that dispersion. To find out the dispersion before averaging, set the averaging factor (FUNCTION 4 in the PROGRAM1 mode) to 1. The turbidimeter directly outputs a non-averaged value for the present turbidity reading and output.

b. Hold Time

Set a hold time greater than the length of time that air bubbles or dust remain on the light-scattering surface. Normally, air bubbles and dust are carried away or disappear in a relatively short time (as short as a few seconds). In practice, however, set a shorter time initially and then increase it a slightly if the option does not function satisfactorily.

c. Sampling Time

In most cases, air bubbles or dust contaminants do not occur in rapid succession. Accordingly, you may not necessarily have to set a short period of sampling time. Setting too short a sampling time may result in a response delay if a drastic change actually occurs in the turbidity of water under measurement. First set a relatively long sampling time, and then make it shorter if there is anything wrong with the behavior of the option. For details on setting in the PROGRAM1 mode, see 6.6.

Notes on Use

Be careful when using this option as the following restrictions apply.

1) The option is designed to work in the MEAS. mode only.

   Upon a change to the MAINT. mode, the turbidimeter resets the hold-time timer or sampling-time timer and the option stops working. Further, the option will not work if in the MAINT. mode, the data item " Hold Analog Output " is set to " Disable. "

2) The option does not work during automatic zero calibration or automatic cleaning. If automatic zero calibration or automatic cleaning begins when the option is active (i.e., during the hold time or sampling time), the option stops working at that moment and the timer is reset.

3) Both the turbidity reading (including the value of the communication data) and the analog output are kept in the hold state.

4) The option does not function during an interval of approximately five seconds right after the turbidimeter is turned on.

5) If the turbidimeter is turned off and then back on when the option is active, the timer is reset.

6) Since the reference clock runs at a period of approximately 1.07 seconds, the actual intervals of both the sampling time and hold time are slightly greater than their respective setpoints.

   For example, a setpoint of 10 seconds equals an actual time interval of approximately 11 seconds (i.e., 10 X 1.07).

6. PROCEDURES FOR CONVERTER OPERATION

The converter incorporates a microprocessor and has automatic cleaning, automatic zero-calibration, and self-diagnostic functions as well as turbidity measuring functions. The converter is operated when display of various data, manual operation of solenoid valves, etc., or entries of operation parameters, etc. are to be executed. This chapter describes key operation procedures, details of indications on the display, etc.

6.1 Components of Operation Panel and Their Functions and Actions

The converter is operated completely with keys on the operation panel. The panel includes display areas for data, modes, function codes, etc. in which measured values and operating statuses are displayed.

Figure 6.1 and Table 6.1 shows the operation panel components and their functions.

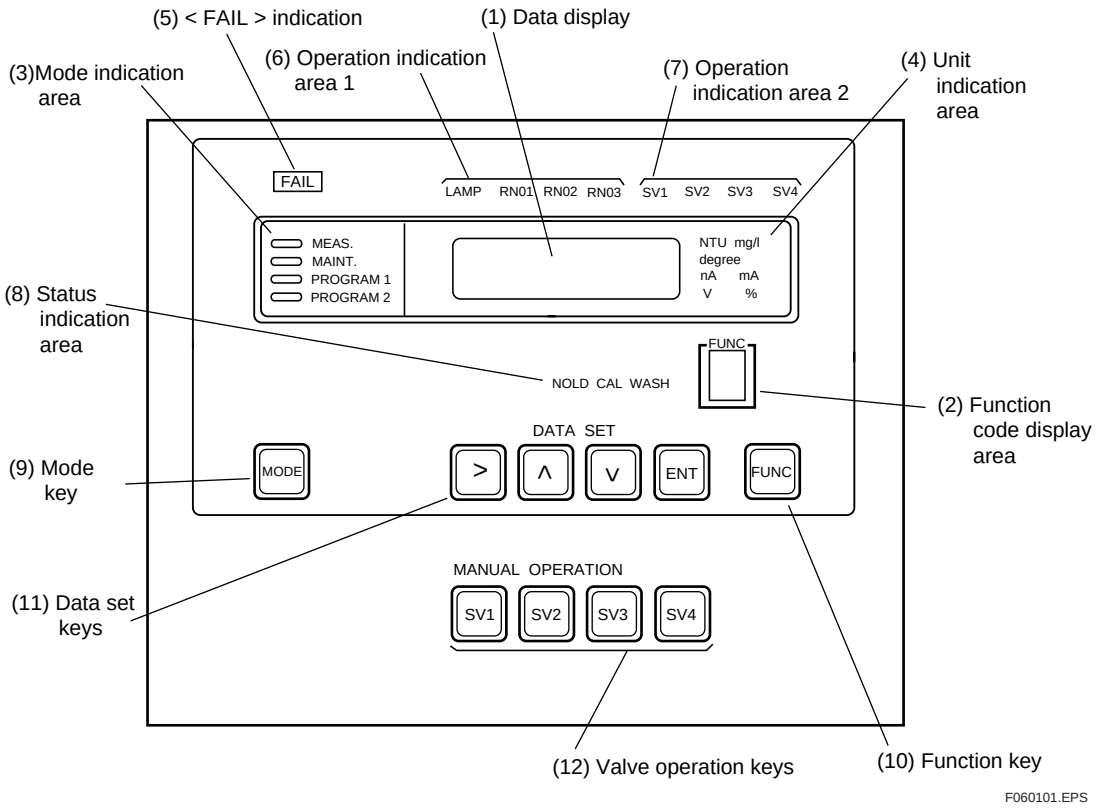

Figure 6.1 Operation Panel

Table 6.1 Operation Keys / Display Indications and Functions

Number in figure	Name	Function
1	Data display (displays in red LED figures)	Displays measured values, set data, messages, etc.
2	Function code display area (in red)	Displays the function code selected.
3	Mode indication area (indicates by lighting up a green lamp)	Indicates the operation mode. The lamp relevant to the current operation mode is lit.
4	Unit indication area (in green: characters in relief)	Indicates the unit of the data. The unit of the data item currently displayed in the data display.
5	< FAIL > indication (in red: characters in relief)	Turns on when the processor fails or other failures are detected.
6	Operation indication area 1 (in green: characters in relief)	Turns on or off in response to the lamp turning on or off or the selected range of the analog output.
7	Operation indication area 2 (in green: characters in relief)	Turns on or off in response to the solenoid valve being on or off.
8	Status indication area (in green: characters in relief)	Lights up, goes out, or flashes corresponding to the " output hold ", " calibration " and " cleaning " statuses.
9	Mode key	Used when selecting an operation mode.
10	Function key	Used when selecting the function code.
11	Data set keys	Used when changing data settings or implementing calibration.
12	Valve operation keys	Used when turning solenoid valves on or off. Every time a key is pressed, the solenoid valve relevant to the key is turned on or off.

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6.2 Operation Modes and Functions

Operation of the turbidimeter is divided principally into three operation modes (modes are classified into four types).

(1) Measurement mode (< MEAS. > mode)

(2) Maintenance mode (< MAINT. > mode)

(3) Setting modes

- Data setting/operation setting mode (< PROGRAM1 > mode)
- Automatic cleaning and zero-calibration setting / failure detection function selection mode (< PROGRAM2 > mode)

Display or setting items for data and command items, such as for calibration, are determined by functions in each mode. Accordingly, various operations require designation of a mode and a function code.

Table 6.2 outlines the modes and the function codes in each mode, For detail on function codes, see subsections 6.2.1 to 6.2.4.

Table 6.2 Outline of Modes and Function Codes

Mode	Function code (FUNCTION)	Description
MEAS.	[1] to [8]	This is the mode for steady operation in which turbidity is measured. If execution of automatic cleaning and zero calibration is selected, a sequence operation is carried out .
MAINT.	[1] to [F]	This is the mode for performing maintenance in which calibration can be done (implemented items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.
PROGRAM. 1	[1] to [F]	Data can be set such as output range setting. (The setting items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.
	[1.] to [F.]	Operating functions such as range switching (automatic, remote / local) and execution/stopping of automatic cleaning can be selected (setting items are selected using the [FUNC] key). The data set key and valve setting keys can be operated.
PROGRAM. 2	[1] to [F]	The cleaning and calibration sequence time can be set (setting items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.
	[1.] to [9.]	Execution/stopping of failure detection can be selected (setting items are selected using the [FUNC] key). The data set key and valve operation keys can be operated.

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6.2.1 Functions in < MEAS. > Mode

Table 6.3 gives details on the functions in the < MEAS. > mode.

Table 6.3 Functions in < MEAS. > Mode

F	Indication	Display range	Example of indication	Initial (default) value	Unit	Remarks
1	Turbidity	-10.00 to 2200	15.0	————	NTU	Degree/mg/l is also possible.
2	Lamp voltage	-0.100 to 6.000	4.900	————	V	
3	Turbidity element detection current	-50.0 to 200 *1	125	————	nA	
4	Reference element detection current	-0.2000 to 2.4000 *2	1.6000	————	V	
5	Analog output in %	-10.0 to 110.0	50.0	————	%	
6	Analog output in mA	2.40 to 21.60	12.00	————	mA	
7	Zero-point error	-30.00 to 30.00	0.02	0.000	NTU	Degree/mg/l is also possible.
8	Slope	-50.0 to 400.0	150.0	100.0	%	
9 | F.	(Not to be selected)					

Note 1: The values in the column for the initial value are those shown when the memory storing the data is initialized. These are partially different from the values set upon shipment from the factory.

(*1), (*2) These are indicated by reversing the sign (+ or -) for the voltage values obtained by placing the AG terminal of the detector to the negative side (-).

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6.2.2 Functions in < MAINT. > Mode

TabIe 6.4 gives details on the functions in the < MAINT. > mode.

Table 6.4 Functions in < MAINT. > Mode

F	Operation	Permissible calibration range	Initial indication	Remarks
1	Zero calibration (zero water)	-10 to 10mV	Measured turbidity value	Uses zero water.
2	Zero calibration (lamp is off)	-10 to 10mV	Measured turbidity value	Automatic turning off of light source
3	Zero-shift calibration (zero-point correction)	-9.000 to 9.000 NTU	Measured turbidity value	Zero-shift calibration (zero correction)
4	Span calibration (standard solution or calibration plate)	50 to 400%	Measured turbidity value	Selection of calibration plate/standard solution
5	Span calibration (sensitivity correction)	0.25 to 4	Measured turbidity value	Sensitivity correction for the standard solution (calibration plate) reference
6	Manual start of automatic cleaning		JEt	Effective for the model wit automatic cleaning
7	Manual start of automatic calibration		A. CAL	Effective for the model with automatic zero calibration
8	Reference sensitivity calibration (*1)		Measured turbidity value	Criteria for slope failure
9	Converter check operation		C. CHEC	Checked by switching to dummy input. Display → 50.0 NTU Output → 12mA
A	Error code indication		E. CHEC	
B	Error reset		CL-Er	
C	Calibration of lamp control reference value	0.6000 to 2.3000V	L. CAL	The lamp voltage is set at 4.9 V and the reference signal is stored as the reference value.
D				
E	Version number indication		1.00	
F	Password setting for changing the adjustment mode		_00	
1. | F.	(Not to be selected)			

(*1) Set the sensitivity after the reference sensitivity calibration performed upon shipment from the factory to 100% and check the slope in normal span calibration taking this value as a reference.

Note 1: The values in the column for the initial value are those shown when the memory storing the data is initialized. These are partially different from the values set upon shipment from the factory.

Note 2: If a function code which is not used is selected, "_ _ _ _ _" is displayed.

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6.2.3 Functions in < PROGRAM1 > Mode

Table 6.5 gives details on the functions in the < PROGRAM1 > mode .

Table 6.5 Functions in < PROGRAM1 > Mode

F	Operation	Setting range / details	Initial value	Remarks
1	Output range 1 setting	0.00 to 2000NTU	L0.000 H10.00	
2	Output range 2 setting	0.00 to 2000NTU	L0.000 H100.0	
3	Output range 3 setting	0.00 to 2000NTU	L0.000 H1000	
4	Average coefrircient setting (time constant setting)	1 to 255	00030	The 90% response time is about 22 seconds.
5	Setting of output value in a failed condition	-10 to 110%	00000	
6	Output setting of line-segment approximation	0 to 100%	00050	
7	Auto-range changeover point setting	70 to 100%	00080	
8	Upper limit alarm setting	-10.0 to 2200.0NTU	2200.0	
9	Lower limit alarm setting	-10.0 to 2200.0NTU	-10.0	
A	Setting of turbidity value by calibration plate	00.000 to 0120.0NTU	10.00	This varies with the calibration plates.
B	Setting of zero-correction factor	-9.000 to 09.000NTU	00.000	
C	Setting of sensitivity correction factor	0.2500 to 4.000	1.0000	
D	Detection level setting	1 to 100%	00010	
E	Hold time setting	1 to 600sec	00060	
F	Sampling time setting	1 to 600sec	00030	
1.	Auto - range selection (*1)	ON/OFF	OFF	ON : Execution OFF : Stop
2.	Remote range selection (*1)	ON/OFF	OFF	ON : Execution OFF : Stop
3.	Local range selection (*1)	_ _1/_ _2/_ _3	_ _1	1 : Output range 1 2 : Output range 2 3 : Output range 3
4.	Output holds setting in the < MAINT. >, < PROGRAM1 >, or < PROGRAM 2 > mode	ON/OFF	ON	ON : Hold OFF : No-hold
5.	Output mode setting in failure occurrence	_ _1/_ _2/_ _3	_ _1	1 : No-hold 2 : Hold 3 : Preset
6.	Setting to output holds for 4 mA or less	ON/OFF	OFF	ON : Execution OFF : Stop
7.	Setting to hold negative turbidity display	ON/OFF	OFF	ON : Execution OFF : Stop
8.	Automatic cleaning or automatic calibration added	ON/OFF	OFF	ON : Execution OFF : Stop
9.	Basic code (sampling specifications) setting	_ _1/_ _2/_ _3	_ _3	1 : Without automatic cleaning and automatic zero calibration 2 : Autmatic cleaning added 3 : Autmatic cleaning and zero calibration added
A.	Automatic cleaning function execution / stop	ON/OFF	ON	ON : Execution OFF : Stop
B.	Automatic calibration function execution / stop	ON/OFF	ON	ON : Execution OFF : Stop
C.	Selection of unit to indicate	_ _1/_ _2/_ _3	_ _1	1 : NTU 2 : mg/ℓ 3 : Degree
D.	Selection of calibration plate / standard solution	ON/OFF	ON	ON : Calibration late OFF : Standard solution
E.	Selection of AUX contact output	ON/OFF	ON	ON : Upper and lower limit alarm OFF : In automatic cleaning or automatic calibration
F.	Bubble retardant	ON/OFF	ON	ON : Execution OFF : Stop

(*1) The priorities of these items are as follows (see subsection 5.2.1)
Auto-range > Remote range > Local range

Note 1: The values in the initial value column are those given when the memory storing the data is initialized. These may be partially different from the values set upon shipment from the factory.

Note 2: If an unused function code is selected, " _ _ _ _ _ " is displayed.

Note 3: If a value out of the set range is entered, " not " is displayed. Pressing the [>] key restores this indication to the data display.

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6.2.4 Functions in < PROGRAM2 > Mode

Table 6.6 gives details on the functions in the < PROGRAM2 > mode.

Table 6.6 Functions in < PROGRAM2 > Mode

F	Operation	Setting range / details	Initial value	Remarks
1	Setting of time range for automatic cleaning	0.1 to 24.0 hours	0002.0	
2	Setting of cleaning calibration ratio	1 to 10 times	00001	
3	Setting of number of cleanings	1 to 20 times	00005	
4	Setting of cleaning time 1 (*1)	10 to 120 seconds	00030	
5	Setting of cleaning time 2 (*2)	10 to 120 seconds	00030	
6	Setting of drain time 1 (*1)	10 to 120 seconds	00010	
7	Setting of drain time 2 (*2)	10 to 120 seconds	00010	
8	Setting of filling time 1 (*1)	10 to 120 seconds	00100	
9	Setting of filling time 2 (*2)	10 to 120 seconds	00100	
A	Setting of relaxation time	30 to 600 seconds	00150	
B				
C	etting of maintenance contact output operation	_ _1/_ _2	_ _2/Closed	1 : Open in operation 2 : Closed in operation
D	Setting of FAIL contact output operation	_ _1/_ _2	_ _1/Open	1 : Open in operation 2 : Closed in operation
E	Setting of upper and lower limit alarm contact output operation	_ _1/_ _2	_ _1/Open	1 : Open in operation 2 : Closed in operation
F	Setting of operation of contact output during automatic cleaning and zero-calibration	_ _1/_ _2	_ _2/Closed	1 : Open in operation 2 : Closed in operation
1.	Selection of execution / stopping of turbidity range-over detection function	ON/OFF	ON	ON : Execution OFF : Stop
2.	Selection of execution/stopping of disconnected-lamp detection function	ON/OFF	ON	ON : Execution OFF : Stop
3.	Selection of execution/stopping of lamp voltage failure detection function	ON/OFF	ON	ON : Execution OFF : Stop
4.	Selection of execution/stopping of A/D circuit failure detection function	ON/OFF	ON	ON : Execution OFF : Stop
5.	Selection of execution/stopping of failure-in-memory-comparison detection function	ON/OFF	ON	ON : Execution OFF : Stop
6.	Selection of execution/stopping of reference voltage failure detection function	ON/OFF	ON	ON : Execution OFF : Stop
7.	Selection of execution/stopping of end-of-lamp-life detection function	ON/OFF	ON	ON : Execution OFF : Stop
8.	Selection of execution/stopping of automatic calibration failure detection function	ON/OFF	ON	ON : Execution OFF : Stop
9.	Selection of execution/stopping of upper and lower limit alarm detection function	ON/OFF	ON	ON : Execution OFF : Stop
A.				
B.				
C.				
D.				
E.				
F.				

(*1) Effective with automatic cleaning
(*2) Effective with automatic cleaning and calibration
Note 1: The values in the initial value column are those given when the memory storing the data is initialized. These may be partially different from the values set upon shipment from the factory. _ _ _ _ _" is displayed.
Note 2: If an unused function code is selected, "
Note 3: If a value out of the set range is entered, " not " is displayed. Pressing the [>] key restores this indication to the data display.

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6.3 Key Operation

6.3.1 Mode Switching

The current operation mode is indicated by the lit mode indicator lamp. The operation modes are switched in turn as shown in Figure 6.2 every time [MODE] key is pressed. However, if a function code other than " 1 " is selected in each mode, that mode is not changed by the first key operation but the function code only returns to " 1 "

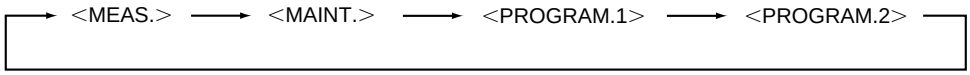

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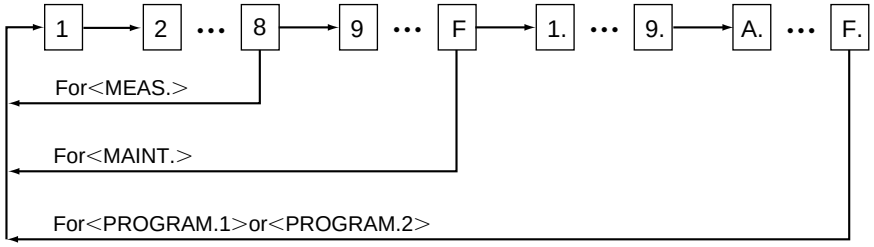
Figure 6.2 Mode Switching by [MODE] Key Operation

6.3.2 Function Switching

Pressing the [FUNC] key switches the function codes. The switched function code is displayed in the function code display area. In addition, the function code contents are different in each mode (see Section 6.2). The selectable number of function codes also changes.



Note : If the [MODE] key is pressed with the function code set to a code other "1", the function code returns to "1".

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Figure 6.3 shows the switching sequence of function codes by the [FUNC] key operation.

6.3.3 Numerical Input

Numerical input is made with the data set keys. Operation of the data set keys becomes effective in the modes other than the < MEAS. > mode. The data set keys include the following four keys.

(a) [>] Key (Digit selection key):

This is used to select the digits of a value of displayed data in the data display that are to be changed. Digits are selected in such a manner that a digit to be changed moves one place to the right from the most significant digit on the left every time this key is pressed and returns to the left end from the right end. When the display is on or off in each mode, pressing the [>] key indicates them alternately. Also, when the display comprises _ _1, _ _2, and _ _3, pressing the [>] key indicates one of them in this order.

(b) [∧] Key (Numeral-up key):

Every time this key is pressed, the numeric value of the selected digit increases in turn ; when it reaches 9, it returns to 0. In the most significant digit, a " - " (minus sign) is inserted next to 9 . However, if the displayed data do not include negative values, the negative sign is not inserted.

(c) [∨] Key (Numeral-down key):

Every time this key is pressed, the numeric value in the selected digit decreases in turn; when it reaches 0, it returns to 9. In the most significant digit, a " - " (minus sign) is inserted next to 0. However, if the displayed data do not include negative values, the negative sign is not inserted,

(d) [ENT] Key (Entry key):

This key is used to enter displayed data. When data are entered, the entire displayed data flash only once.

6.3.4 Opening / Closing Valves

The opening or closing of a solenoid valve is performed with the valve operation key in the maintenance mode. When a solenoid valve operates, the relevant lamp is lit. Regardless of a solenoid valve's open/close status in the maintenance mode, if the mode is changed to the < MEAS. > mode, e.g., for the specification " with automatic cleaning and automatic calibration ", the predetermined sequential operation is performed and the solenoid valves automatically open or close.

Table 6.7 shows the use of solenoid valves based on the sampling specifications (basic code).

Table 6.7 Sampling Specifications (MS Code) and Use of Solenoid Valves

System	SV1	SV2	SV3	SV4
with sampling system	×	×	×	×
with sampling system and automatic cleaning	○	○	×	×
with sampling system and automatic cleaning and automatic zero c alibration	○	○	○	○

× : Not used
○ : Used

Note : SV1 and SV3 denote motor -operated valves and SV2 and SV4,solenoid valves.

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6.4 Operation in < MEAS. > Mode

Each data item in Table 6.3 is displayed by [FUNC] key operation. In this section, the functions are described in the following order:

(1) Turbidity

(2) Lamp voltage

(3) Turbidity element detection current

(4) Reference element detection voltage

(5) Analog output in %

(6) Analog output in mA

(7) Zero-point error

(8) Slope

(1) Turbidity (FUNCTION " 1 ")

Turbidity is displayed in the range of - 10.00 to 2200 NTU. The unit that is displayed can be selected from " NTU ", " mg/l ", or " degree " in the < PROGRAM1 > mode and with FUNCTION " C.".

(2) Lamp voltage indication (FUNCTION " 2 ")

The output voltage of the converter to the lamp (across terminals P1 and P2) is displayed.

(3) Turbidity element detection current (FUNCTION " 3 ")

The signal detected by the turbidity detecting light-receiving element in the detector is displayed as the current value (converted value).

(4) Reference element detection voltage (FUNCTION " 4 ")

The signal detected by the light-receiving element for the amount of light from the lamp is displayed as the voltage.

(5) Analog output in % (FUNCTION " 5 ")

The current output signal is displayed in a % of the selected output range span.

(Example) In the case of output range: 0 to 10 NTU, and

Turbidity indication: 6.00 NTU

$$\% \text{ Indication} = \frac{6.00}{10-0} \times 100 = 60.0\ \%$$

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The analog output is sent out in the range of - 10 to 110 % of the output range span.

(6) Analog output in mA (FUNCTION " 6 ")

The current analog output value is displayed in a value converted to mA. The value is directly displayed for a 4 to 20 mA output, but for a 1 to 5 V output, it is displayed by converting it into a 4 to 20 mA output.

(7) Zero-point error (FUNCTION " 7 ")

The measuring voltage signal for zero water or with the light source turned off at zero calibration is displayed in a value converted to turbidity. If the measuring signal at zero calibration exceeds the range of - 10 to 10 mV, " Err21 " is displayed.

(8) Slope (FUNCTION " 8 ")

When the sensitivity at the reference sensitivity calibration is taken as 100%, this indication displays the ratio as a percentage of the sensitivity obtained at usual span calibration to 100%. If the sensitivity exceeds the range of 50 to 400% at span calibration, " Err22 " is displayed.

6.5 Operation in < MAINT. > Mode

This section describes key operations by specifying the functions in the < MAINT. > mode and describes the key operations in the following order:

(1) Zero calibration (with zero water)
(2) Zero calibration (with lamp turned off)
(3) Zero-shift calibration (Zero-point correction)
(4) Span calibration (with standard solution or calibration plate)
(5) Span calibration (sensitivity correction)
(6) Manual start of automatic cleaning
(7) Manual start of automatic calibration
(8) Reference sensitivity calibration
(9) Converter check operation
(10) Error code display
(11) Error resetting
(12) Reference lamp control value calibration
(13) Version number display
(14) Password entry to switch to the adjustment mode

(1) Zero Calibration (with " zero water ") [FUNCTION " 1 "]

The zero-calibration operation using " zero water ". For the valve operating procedures, see Section 7.6.

The following is a description of the key operations:

	(Example of display)
1. Select FUNCTION " 1 " in the < MAINT. > mode.	⇒ 000.04 NTU
2. Press the [ENT] key after the display becomes stable.	⇒ The " CAL " lamp begins to flash.
3. Press the [>] key.	⇒ 000.00 NTU is displayed.
4. Press the [ENT] key to terminate calibration.	⇒ 000.00 NTU The entire display flashes once and the " CAL " lamp goes out.

In addition, at operation 4., the measured signal at the zero point is checked and if the permissible range (- 10 to 10 mV) is exceeded, Err21 (zero calibration overrange) is displayed (see Section 5.3 *3). In this case, the " FAIL " lamp is not lit and a FAIL contact is not output.

An error message can be reset by pressing the [ENT] key and the display returns to the turbidity indication. Wait until the display becomes stable and then begin from step 2 again.

At any stage of zero-calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless the operation of 4.. is carried out.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(2) Zero Calibration (with lamp turned off) (FUNCTION " 2 ")

The zero-calibration operation is done by automatically turning off the lamp. Only in a measured turbidity exceeding 200 NTU, can zero calibration be performed simply in the following operations: A turbidity reading with the lamp turned off reads a value 1 NTU smaller than a reading using " zero water ".

	(Example of display)
1. Select FUNCTION " 2 ", in the < MAINT. > mode.At this time, the lamp is still lit.	⇒ 002.00 NTU
2. Press the [ENT] key. The lamp goes out and the displayed value becomes smaller.	⇒ 000.50 NTU The CAL lamp flashes.
3. Wait one minute or more and after the display becomes stable, and press the [>] key.	⇒ 000.00 NTU is displayed.
4. Press the [ENT] key to calibrate.	⇒ 000.00 NTU The entire display flashes once and then the" CAL " lamp goes out.

In addition, at operation 4., the zero-calibration range is checked and if the permissible range (- 10 to 10 mV) is exceeded, Err 21 (zero-calibration overrange) is displayed (see Section 5.3 *3). In this case, the " FAIL " lamp is not lit and a FAIL contact is not output.

The error message can be reset by pressing the [ENT] key and the display returns to the turbidity indication. Wait until the display becomes stable and then begin from step 2. again.

In any stage of zero-calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation of 4. is carried out. Also, since the lamp voltage returns to the control voltage when the turbidimeter resets from the function for calibration with the lamp turned off, a little time is necessary until the turbidity reading becomes stable. When the mode is to be changed to the < MEAS. > mode, change the mode after waiting for five minutes or more.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(3) Zero-shift Calibration (FUNCTI0N " 3 ")

At any turbidity value, this is an operation to zero-shift a turbidity reading within the permissible range (± 9 NTU).

For details on the function, see Section 5.3 (*3). The zero- correction factor obtained in this calibration can be displayed and directly changed in FUNCTION " B " in the < PROGRAM1 > mode.

The operation procedures are as follows:

	(Example of display)
1. Select FUNCTION " 3 " in the < MAINT. > mode.	⇒ 000.13 NTU
2. Wait until the display becomes stable, and then press the [ENT] key.	⇒ 000.13 NTU The CAL lamp flashes.
3. Press the [>] key.	⇒ 00000. NTU The display is now ready for determination of the decimal point position.
4. Press the [>] key to determine the position of decimal point. Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, the decimal point then moves to the second digit from the left.	⇒ 000.00 NTU
5. Press the [ENT] key.	⇒ 0<u>0</u>0.00 NTU The second digit from the left flashes and waits for the turbidity setting.
6. Select a digit with the [>] key and set the turbidity value using the [∧] or [∨] key. Every timethe [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left.	⇒ 000.2<u>2</u> NTU
7. Press the [ENT] key to terminate calibration.	⇒ 000.22 NTU The entire display flashes once and the CAL lamp goes out.

In addition, if the turbidity value set in operation 7. exceeds the permissible setting range (0 to 2200 NTU), " not " is displayed. As this setpoint is out of range, reset the error message by pressing the [>] key and continue the operation from step 2. Also, check the zero-correction factor; if it exceeds the permissible range (± 9 NTU), " Err23 " is displayed. In this case, the " FAIL " lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operations from step 2. At any stage of zero-shift calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation 7. is carried out.

(4) Span Calibration (by standard solution or calibration plate) (FUNCTION " 4 ")

This is the operation for normal span calibration (by the calibration plate or standard solution). For details on valve operation and others, see Sections 7.6 and 7.7. Select whether the calibration plate or standard solution is used in span calibration in FUNCTION " D " in the < PROGRAM1 > mode,

The following is the key operation procedure:

(a) Span calibration with calibration plate

	(Example of display)
1. Select FUNCTION " 4 " in the < MAINT. > mode.	⇒ 0012.5 NTU
2. Wait until the display becomes stable, and then press the [ENT] key.	⇒ 0012.5 NTU The CAL lamp flashes.
3. Press the [>] key.	⇒ 0012.5 NTU The preset turbidity value of the calibration plate is displayed.
4. Press the [ENT] key to terminate calibration.	⇒ 0012.5 NTU The display flashes once and the CAL lamp goes out.

In operation 4. check the difference between the current turbidity value and the calibration plate turbidity value. If it exceeds the permissible range (± 50% of the preset calibration plate turbidity value), " Err24 " is displayed. In this case, the " FAIL " lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key, check that the calibration plate is set in place and continue operation from step 2.

Also, check the ratio of the current sensitivity (slope) to the reference sensitivity.

If it exceeds the permissible range (50 to 400%), " Err22 " is displayed (see Section 5.3 *3). The error message is reset by pressing the [ENT] key. Perform operation from step 2. again.

At any stage of zero-shift calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation 4. is carried out.

Note: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

(b) Span calibration with standard solution

	(Example of display)
1. Select FUNCTION " 4 " in the < MAINT. > mode.	⇒ 0020.5 NTU
2. Wait until the display becomes stable, and then press the [ENT] key.	⇒ 0020.5 NTU The CAL lamp flashes.
3. Press the [>] key.	⇒ 00000. NTU The display is now ready for determination of the decimal point position.
4. Press the [>] key to determine the position of -the decimal point. Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, it moves to the second digit from the left.	⇒ 0000.0 NTU
5. Press the [ENT] key.	⇒ 0000.0 NTU The second digit from the left flashes and waits for the turbidity setting.
6. Select a digit with the [>] key and set the turbidity value of the standard solution using the [∧] or [∨] key. Every time the [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left.	⇒ 0020.0 NTU
7. Press the [ENT] key to terminate calibration.	⇒ 0020.0 NTU The entire display flashes once and the CAL lamp goes out.

If the turbidity value set in operation 7. exceeds the permissible setting range (0 to 2200 NTU), " not " is displayed. In this case, the " FAIL " lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operation from step 2.

Also, check the ratio of the current sensitivity (slope) to the reference sensitivity. If it exceeds the permissible range (50 to 400%), " Err22 " is displayed (see Section 5.3 *3). The error message is reset by pressing the [ENT] key. Perform operation from step 2. again.

At any stage of zero-shift calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. Calibration computation is not performed unless operation 7. is carried out.

Note1: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

Note 2: Conduct the span calibration of this meter using a standard solution in the complete range of linearity from 0 to 200 NTU. It is strongly recommended that a formazine solution ranging from 10.0 to 100 NTU be used as the standard solution for the span calibration.

(5) Span Calibration (sensitivity correction) (FUNCTION " 5 ")

Apart from the sensitivity based on the calibration plate (or standard solution) , another corrective sensitivity can be provided. For details on this function, see Section 5.3 (*3). The sensitivity correction factor can be displayed and directly changed using FUNCTION " C " in the < PROGRAM1 > mode. Valve statuses in the operation of this function are the same as those in the measurement status.

(Example of display)

1. Select FUNCTION " 5 " IN the < MAINT. > mode. ⇒ 0105.0 NTU
2. Wait until the display becomes stable, and then press the [ENT] key. ⇒ 0105.0 NTU
   The CAL lamp flashes.
3. Press the [>] key. ⇒ 00000. NTU
   The display is now ready for determination of the decimal point position.
4. Press the [>] key to determine the position of the decimal point.
   Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, it moves to the second digit from the left. ⇒ 0<u>0</u>0.00 NTU
5. Press the [ENT] key. ⇒ 0<u>0</u>00.0 NTU
   The second digit from the left flashes and waits for the turbidity setting.
6. Select a digit with the [>] key and set the desired turbidity value using the [∧] or [∨] key. Every time the [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left. ⇒ 0100.<u>0</u> NTU
7. Press the [ENT] key to terminate calibration. ⇒ 0100.0 NTU
   The entire display flashes once and the CAL lamp goes out.

If the turbidity value set in step 7. exceeds the permissible setting range (0 to 2200 NTU), " not " is displayed. In this case, the " FAIL " lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operation from step 2.

Also, check the ratio of the sensitivity correction to the current sensitivity. If it exceeds the permissible range (0.25 to 4), " Err22 " is displayed. The error message is reset by pressing the [ENT] key. Perform operation from step 2. again.

(6) Manual Start of Automatic Cleaning (FUNCTION " 6 ")

This is the operation to manually start the automatic cleaning operation. For specification of automatic cleaning, this function can be used. For details on automatic cleaning, see Subsection 4.2.3.

The following is the procedure for this function:

(Example of display)

1. Select FUNCTION " 6 " in the < MAINT. > mode. ⇒ " JEt " is displayed.
2. Press the [ENT] key. ⇒ The WASH lamp flashes and automatic cleaning starts.
3. The predetermined cleaning operation is carried out. ⇒ A turbidity value is displayed during cleaning.
4. Termination
   If cleaning is to be repeated, operate from step 2) again. ⇒ " End " is displayed. The WASH lamp goes out.

Even if " contact output during automatic cleaning and calibration " is selected as an auxiliary contact output, the contact is not actuated in a manual start of the automatic cleaning operation. A digital output is also not sent out. During cleaning, the cleaning operation can be stopped if the mode or the function is switched to another mode or function using the [MODE] key or [FUNC] key. In this case, the solenoid valve automatically returns to the status at the start of measurement.

(7) Manual Start of Automatic Calibration (FUNCTION " 7 ")

This is the operation to manually start the automatic calibration operation. For specification of automatic calibration, this function can be used. For details on automatic calibration, see subsection 4.2.3.

The following is the procedure for this function:

(Example of display)

1. Select FUNCTION " 7 " in the < MAINT. > mode. ⇒ " A.CAL " is displayed.
2. Press the [ENT] key. ⇒ The CAL lamp flashes and automatic calibration starts.
3. The predetermined calibration operation is carried out. ⇒ The turbidity value is displayed during cleaning.
4. Termination If cleaning is to be repeated, operate from step 2. again. ⇒ " End " is displayed. The CAL lamp goes out.

Even if " contact output during automatic cleaning and calibration " is selected as an auxiliary contact output, the contact is not actuated in a manual start of the automatic calibrating operation. A digital output is also not sent out.

During calibration, the calibration operation can be stopped if the mode or the function is moved to another mode or function using the [MODE] key or [FUNC] key. In this case, the solenoid valves automatically return to the statuses at the start of measurement. If a similar operation is performed after completing the calibration computation, that calibration becomes effective.

(8) Reference Sensitivity Calibration (FUNCTION " 8 ")

The reference sensitivity is determined in this operation using the standard solution upon the shipment from the factory. The sensitivity obtained at that time is the basis for an abnormal sensitivity check at normal span calibration and for the sensitivity (slope) display. Usually, this function is not used except upon shipment from the factory. The valve operations and supply procedures for the standard solution are the same as those at span calibration. For details, see Section 7.7.

The following is the procedure for this function:

	(Example of display)
1. Select FUNCTION " 8 " IN the < MAINT. > mode.	⇒ 0105.0 NTU
2. Wait until the display becomes stable, and then press the [ENT] key.	⇒ 0105.0 NTU The CAL lamp flashes.
3. Press the [>] key.	⇒ 00000. NTU The display is not ready for determination of the decimal point position.
4. Press the [>] key to determine the position of the decimal point. Every time the key is pressed, the decimal point moves to the right and when the least significant digit is reached, it moves to the second digit from the left.	⇒ 000.00 NTU
5. Press the [ENT] key.	⇒ 0000.0 NTU The second digit from the left flashes and waits for the turbidity setting.
6. Select a digit with the [>] key and set the turbidity value of the standard solution using the [∧] or [∨] key. Every time the [>] key is pressed, the flashing digit moves to the right and when the least significant digit is reached, it moves to the second digit from the left.	⇒ 0100.0 NTU
7. Press the [ENT] key to terminate calibration.	⇒ 0100.0 NTU The entire display flashes once and the CAL lamp goes out.

If the turbidity value set in step 7. exceeds the permissible setting range (0 to 2200 NTU), " not " is displayed. In this case, the " FAIL " lamp is not lit and a FAIL contact is not output. Reset the error message by pressing the [ENT] key and continue operation from step 2.

Also in reference sensitivity calibration, the permissible sensitivity range is not specifically determined in calibration. If calibration of this function is performed, the slope display in the < MEAS. > mode becomes 100.0%. In any stage of reference sensitivity calibration operation, pressing the [MODE] key or [FUNC] key allows switching to another mode or function. The calibration computation is not performed unless operation 7. is carried out.

Note1: At this calibration, the turbidity not multiplied by the correction factor from the zero-shift calibration (zero correction) in (3) or span calibration (sensitivity correction) in (5) is displayed.

Note 2: Conduct the reference sensitivity calibration of this meter in a complete range of linearity from 0 to 200 NTU. It is strongly recommended that a formazine solution ranging from 10 to 100 NTU be used as the standard solution for the span calibration.

(9) Converter Check Operation (FUNCTION " 9 ")

This operation checks the operation of the converter by switching the converter input signal from a measured signal to a simulated signal. The following is the procedure for this function:

(Example of display)

1. Select FUNCTION " 9 " in the < MAINT. > mode. ⇒ " C.CHEC " is displayed.
2. Press the [ENT] key. ⇒ 0050.0 NTU

The converter is normal if the turbidity reading and analog output satisfy the following conditions:

Turbidity reading: 50.0±0.5 NTU

put: 12.00±0.16 mA (or 4 to 20 mA output)

3.00±0.05 V (for 1 to 5V output)

If the analog output in the maintenance mode is set to " hold ", the analog output is held at 12 mA (or 3 V) in this operation. When the mode or function is switched to another mode or function using the [MODE] or [FUNC] key, the converter input returns to a measured signal from the simulated input. In this case, a little time is needed until the reading becomes stable. If the < MEAS. > mode is required, wait for one minute or more and then change the mode.

Note: The time required for the reading to stabilize in returning to a measured signal from the simulated input depends on the averaging coefficient preset in FUNCTION " 4 " in the < PROGRAM1 > mode.
If the data (30) set on shipment from the factory are changed, the extra time is needed.

(10) Error Code Display (FUNCTION " A ")

If the FAIL lamp is lit, an error code is not displayed at the time of an error occurrence. This function is used to confirm an error code. Table 6.8 shows error codes displayed with this function and their contents.

Table 6.8 Error Codes and Their Contents

Error code	Contents	Mode for detection
Err11	Turbidity overrange	MEAS.
Err12	Lamp disconnection	MEAS.
Err13	Lamp voltage error	MEAS.
Err14	A/D circuit error	Any mode
Err15	Memory comparison error	Any mode
Err18	Reference signal voltage error	MEAS.
Err25	Service life of lamp	MEAS.
Err26	Automatic zero-calibration error	MEAS.

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The following is the procedure for this function:

(Example of display)

1. Select FUNCTION " A " in the < MAINT. > mode. ⇒ " E.CHEC " is displayed.
2. Press the [ENT] key. ⇒ " Err11 "
   " Err11 " flashes. If there is more than one error, they appear in turn.
3. Press the [ENT] key. ⇒ " E.CHEC " is displayed.

If this function is operated when there is no error, " Good " is displayed. For troubleshooting when errors occur, see Chapter 8.

(11) Error Resetting (FUNCTION " B ")

This function can reset error statuses (FAIL lamp and FAIL contact output). An error status is automatically reset at an instance when the causes of an error are removed but this function can reset the error even if the causes are not removed. However, if the causes of the error still remain when the mode is changed after resetting and moved to each error detection mode, that error is again detected.

The following is the procedure for this function:

(Example of display)

1. Select FUNCTION " B " in the < MAINT. > mode. ⇒ " CL_Er " is displayed.
2. Press the [ENT] key. ⇒ " CL_Er " display flashes once and the error is reset.

For troubleshooting when errors occur, see Chapter 8.

(12) Reference Lamp Control Value Calibration (FUNCTION " C ")

This function determines the reference signal of the reference light-receiving element when the amount of light from the lamp is controlled. Be sure to carry out this calibration after replacing the lamp and then do a span calibration (calibration plate). For the lamp replacement procedure, see Section 7.5.

The following is the procedure for this function:

(Example of display)

1. Select FUNCTION " C " in the < MAINT. > mode. ⇒ " L_CAL " is displayed.
2. Press the [ENT] key. The lamp voltage is fixed at 4.9 V. ⇒ 1.4203 V
   The reference signal is displayed.
3. Wait for about 5 minutes or more until the display becomes stable and then press the [ENT] key. ⇒ 1.4203 V
   The entire display flashes once and the reference value is stored.
4. Terminated.

When step 3. is operated, if the displayed reference signal exceeds the permissible range (0.6 to 2.3 V), " Error " is displayed. The error message can be reset by pressing the [ENT] key. Repeat the procedure from the adjustment of the lamp's position.

If the mode is switched to another mode using the [MODE] or [FUNC] key after step 2. or after calibration is terminated by operating step 3., lamp-voltage control restarts . As it takes a little time until the lamp voltage stabilizes, allow 30 minutes or more before starting measurement, Since the lamp voltage does not change unless step 2. is operated, a waiting time is not necessary.

(13) Version Number Display (FUNCTION " E ")

This function displays the converter program version number.

(Example of display)

1. Select FUNCTION " E " in the < MAINT. > mode. ⇒ " 1.00 "

(14) Password Entry to Switch to the Adjustment Mode (FUNCTION " F ")

This function is for only utilization of the service mode by service personnel of Yokogawa Electric. Thus, this function is not usually operated.

6.6 Operation in < PROGRAM1 > Mode

In the < PROGRAM1 > mode, data setting operations, such as output range, and operating status setting operations, such as auto range selection, are carried out.

Functions " 1 " to " F ": Data settings

Functions " 1. " to " F. ": Operating status settings

Section 6.6 describes key operations which specify each function in the < PROGRAM1 > mode and the displays accompanying those key operations in the following order:

(1) Setting output ranges 1, 2, and 3

(2) Setting averaging coefficient (time constant)

(3) Setting output value if an error occurs

(4) Setting line-segment function output

(5) Setting change-over point in auto-ranging

(6) Setting upper limit alarm value

(7) Setting lower limit alarm value

(8) Setting turbidity value of calibration plate

(9) Setting zero-correction factor

(10) Setting sensitivity correction factor

(11) Setting detection level for bubble vetardant

(12) Setting hold time for bubble retardant

(13) Setting sampling time for bubble refardant

(14) Auto-range selection

(15) Remote range selection

(16) Local range setting

(17) Setting output hold in maintenance

(18) Setting output mode if a failure occurs

(19) Setting output holds for 4 mA or less

(20) Setting negative turbidity display hold

(21) Setting display-hold in automatic cleaning and calibration

(22) Selecting MS codes (sampling specifications)

(23) Selecting execution/stop of automatic cleaning function

(24) Selecting execution/stop of automatic calibration function

(25) Selecting designation of unit

(26) Selecting calibration plate or standard solution

(27) Selecting AUX (C1, C2) contact outputs

(28) Selecting excution / stop of bubble refardant function

(1) Setting Output Ranges 1, 2, and 3 (Functions " 1, " " 2, " and " 3 ")

The analog output is sent out by being selected for one of the output ranges, 1, 2, or 3. There are three output range selections as shown below.

- Auto-range selection
- Remote range selection
- Local range selection

For details on selection, see (14), (15), and (16) in Section 6.6. In this item, the setting of upper and lower limit values in output ranges 1, 2, and 3 is described taking output range 1 as an example.

(Example of display)

1. Select FUNCTION " 1 " in the < PROGRAM1 > mode. If the lower limit is not to be changed, start operation from step 6. ⇒ L00.00 NTU
2. Press the [>] key. ⇒ L0000. NTU
   The display is now ready for determination of the decimal point position.
3. Determine the decimal point position with the [>] key. Every time the [>] key is pressed, the decimal point moves to the right one digit and when the least significant digit is reached, it returns to the most significant digit. ⇒ L0.000 NTU
4. Press the [ENT] key. ⇒ L0.000 NTU
   The most significant digit flashes and waits for the numerical value entry.
5. Select a digit with the [>] key and set the desired lower limit using the [∧] or [∨] key. Every time the [>] key is pressed, the flashing digit moves to the right one digit and when the least significant digit is reached, it returns to the most significant digit. ⇒ L0.500 NTU
6. When press [ENT] key, current upper limit is indicated ⇒ H10.00 NTU
7. Press the [>] key. ⇒ H0000.NTU
   The display is now ready for determination of the decimal point position.
8. Determine the position of the decimal point using the [>] key. Every time the [>] key is pressed, the decimal point moves to the right one digit and when it reaches the least significant digit, it returns to the most significant digit. ⇒ H00.00 NTU
9. Press the [ENT] key. ⇒ H00.00 NTU
   The most significant digit flashes and waits for the numerical value entry.

10. Select a digit and set the desired upper limit using the [∧] or [∨] key. Every time the [>] key is pressed, the decimal point moves to the right one digit and when it reaches the least significant digit, it returns to the most significant digit. ⇒ H020.0 NTU
11. By pressing the [ENT] key, the upper and lower limits are entered.The entire display flashes once. ⇒ H020.0 NTU
    The entire display flashes once.
12. When the [ENT] key is pressed, the procedure returns to 1. ⇒ L05.00 NTU

In operation of step 6. or 11., if the upper and lower limits are beyond the permissible range (0 to 2000 NTU), " not " is displayed. In this case, reset the message by pressing the [>] key and repeat the operations from step 2.

Also in step 11, if the span between the upper and lower limits does not meet the following conditions when checked, " not " is displayed. Reset the message by pressing the [>] key in a similar manner and repeat the operations from step 2.

Note: The accuracy of the meter described in this manual is warranted for more than 10 NTU of upper limit setpoint.

Range span (Upper limit - lower limit) ≧ 20% of the upper limit ≧ 2.00 NTU

If the upper and lower limits are only to be confirmed, pressing the [ENT] key alternately displays L and H.

If the auto-range switching function is to be used set the ranges as shown below.

- Set 0.000 NTU for all lower limits (L).
- Set, the upper limits (H) in the following manner:
  Range 1 ≦ Range 2 ≦ Range 3
- If two-range operation is required, set Range 2 = Range 3.

• If one-range operation is required, set Range 1 = Range 2 = Range 3.

(2) Setting Averaging Coefficient (time constant) (FUNCTION " 4 ")

The converter display and analog output are computed for averaging by the program. In this setting, the extent of averaging (signal time constant) can be changed. Table 6.9 shows an approximate correspondence between the averaging coefficient and a 90% response time.

The 90% response time is about the averaging coefficient X 0.75 seconds. This coefficient is set at 30 (about 22 seconds for a 90% response time) upon shipment from the factory. If the fluctuation of measured readings is large, e.g., due to suspended matter in the measurement object, change the averaging coefficient as necessary.

Table 6.9 Averaging Coefficient and 90% Response Time

Averaging coefficient	Standard for 90% response time
10	Approx. 8 sec.
20	Approx. 15 sec.
30	Approx. 22 sec.
40	Approx. 30 sec.
50	Approx. 38 sec.
100	Approx. 75 sec.

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The following is the procedure for the setting operation:

(Example of display)

1. Select FUNCTION " 4 " in the < PROGRAM1 > mode. ⇒ 00030
2. Press the [>] key. ⇒ 00030
   The most significant digit flashes.
3. Select a digit using the [>] key and set it to the desired value using the [∧] or [∨] key. ⇒ 00040
   The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the value. ⇒ 00040
   The entire display flashes once.

In addition, in step 4., if the set value is beyond the permissible range (1 to 255), " not " is displayed. Reset the message by pressing the [>] key and repeat operations from step 2.

Note: If calibration is performed using the calibration plate in FUNCTION " 4 " in the < MAINT. > mode, the averaging coefficient automatically changes to 10 regardless of this setting.

(3) Setting Output Value If an Error Occurs

If " preset " (_ _ 3) is selected in the output mode setting (FUNCTION " 5 " in the < PROGRAM1 > mode) when an error occurs, the analog output when the error occurs is fixed at this setting value. Display and set the setpoint in the ratio (%) to the analog output span. The following is an example:

(Example) For a setpoint at " 50% ",

The output value holds at 12 mA when an error occurs,

The output value holds at 3 V when an error occurs,

The following is the setting key operation:

	(Example of display)
1. Select FUNCTION " 5 " in the < PROGRAM1 > mode.	⇒ 00000 %
2. Press the [>] key.	⇒ 00000 % The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [^] or [v] key.	⇒ 00050 % The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] I key to enter the set value.	⇒ 00050 % The entire display flashes once.

In step 4., if the set value is beyond the permissible range (- 10 to 110), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(4) Setting Line-segment Function Output (FUNCTION " 6 ")

Analog output can be provided in the form of a line segment. Set the break point for such a line segment in this function. A line segment is output, being the set value (percentage of the output range span) as the break point at 50 % of the output signal span (4 to 20 mA or 1 to 5 V). For details on the function, see Subsection 5.2.2 (1). The following is the procedure for the setting operations:

(Example of display)

1. Select FUNCTION " 6 " in the < PROGRAM1 > mode. ⇒ 00050 %
2. Press the [>] key. ⇒ 00050 %
   The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [∧] or [∨] key. ⇒ 00060 %
   The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the set value. ⇒ 00060 %
   The entire display flashes once.

In step 4., if the set value is beyond the permissible range (0 to 100 %), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(5) Setting Change-over Point in Auto-ranging (FUNCTION " 7 ")

If auto-range is used, the range is changed over at the point set here. The changeover point is displayed and set at a ratio (%) to the upper limit setpoint of the range. The following shows the operating manner:

- The time to change over from the lower range to the higher range is the point where measured values become larger than the change-over point in the lower range .
- The timing to change over from the higher range to the lower range is a point where measured values become 10 % smaller than the change-over point in the lower range.

The following describes the setting key operations:

	(Example of display)
1. Select FUNCTION " 7 " in the < PROGRAM1 > mode.	⇒ 00080%
2. Press the [>] key.	⇒ 00080 % The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [∧] or [∨] key.	⇒ 00090 % The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the set value.	⇒ 00090 % The entire display flashes once.

In step 4., if the set value is beyond the permissible range (70 to 100%), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(6) Setting Upper Limit Alarm Value (FUNCTION " 8 ")

If the upper and lower limit alarm detection function is set to " execution " (FUNCTION " 9. " in < PROGRAM2 > mode), when a measured value exceeds this setpoint, the MEAS lamp flashes and if AUX (C1, C2) contacts are set for upper and lower limit alarms (FUNCTION " E. " in < PROGRAM1 > mode), the contact output is actuated. Alarm hysteresis is 2% of the setpoint.

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " 8 " in the < PROGRAM1 > mode . ⇒ 2200.0 NTU
2. Press the [>] key. ⇒ 2200.0 NTU
   The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [∧] or [∨] key. ⇒ 1000.0NTU
   The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the set value. ⇒ 1000.0 NTU
   The entire display flashes once.

In step 4., if the set value is beyond the permissible range (- 10 to 2200 NTU), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(7) Setting Lower Limit Alarm Value (FUNCTION " 9 ")

If the upper and lower limit alarm detection function is set to " execution " (FUNCTION " 9. " in < PROGRAM2 > mode), when a measured value is below this setpoint, the MEAS lamp flashes and if AUX (C1, C2) contacts are set for upper and lower limit alarms (FUNCTION " E. " in < PROGRAM1 > mode), the contact output is actuated. Alarm hysteresis is 2 % of the setpoint.

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " 9 " in the < PROGRAM1 > mode. ⇒ -010.0 NTU
2. Press the [>] key. ⇒ -0̲10.0 NTU
   The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [^] or [v] key. ⇒ 00̲0.0 NTU
   The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the set value. ⇒ 0000.0 NTU
   The entire display flashes once.

In step 4., if the set value is beyond the permissible range (- 10 to 2200 NTU), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(8) Setting Turbidity Value of Calibration Plate (FUNCTION " A ")

Upon shipment from the factory, the value of the attached calibration plate has been set.

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " A " in the < PROGRAM1 > mode. ⇒ 009.00 NTU
2. Press the [>] key. ⇒ 009.00 NTU
   The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [∧] or [∨] key. ⇒ 009.50 NTU
   The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit
4. Press the [ENT] key to enter the set value. ⇒ 009.50 NTU
   The entire display flashes once.

In step 4., if the set value is beyond the permissible range (0 to 120 NTU), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(9) Setting Zero-Correction Factor (FUNCTION " B ")

The zero-correction factor obtained in zero-shift calibration (zero correction) (FUNCTION " 3 " in < MAINT. > mode) can be displayed or directly changed. For details on the zero-shift calibration function, see Section 5.3 (*3).

The following is the setting key operations:

	(Example of display)
1. Select FUNCTION " B " in the < PROGRAM1 > mode. If the display is only to be confirmed, operations of 2., 3., and 4. are not necessary.	⇒ 00.000 NTU
2. Press the [>] key.	⇒ 00.000 NTU The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [∧] or [∨] key.	⇒ 00.050 NTU The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the set value.	⇒ 00.050 NTU The entire display flashes once.

In step 4., if the set value is beyond the permissible range (±9 NTU), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(10) Setting Sensitivity Correction Factor (FUNCTION " C ")

The sensitivity correction factor obtained in span calibration with sensitivity correction (FUNCTION " 5 " in < MAINT. > mode) can be displayed or directly changed. For details on span calibration function, see Section 5.3 (*3).

The following is the setting key operations:

(Example of display)

1. Select FUNCTION " C " in the < PROGRAM1 > mode. If the display is only to be confirmed, operations 2., 3., and 4. are not necessary. ⇒ 1.0000
2. Press the [>] key. ⇒ 1. 0000
   The most significant digit flashes.
3. Select a digit with the [>] key and set it to the desired value using the [∧] or [∨] key. ⇒ 1.2000
   The flashing digit moves to the right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key to enter the set value. ⇒ 1.2000
   The entire display flashes once.

In step 4., if the set value is beyond the permissible range (0.25 to 4), " not " is displayed. Reset the message by pressing the [>] key and repeat the operations from step 2.

(11) Setting Detection Level for Bubble Retardant (FUNCTION " D ")

1. Select FUNCTION " D " in the PROGRAM1 mode. ⇒ 00010% (example of reading)
2. Press the > key. ⇒ 00010% The MSD blinks.
3. Using the > key, select a digit and then press the [∧] and [∨] keys to set the digit to the desired value. ⇒ 00020% Blinking shifts right, to the LSD, and then returns to the MSD.
4. Press the ENT key to confirm your setting. ⇒ 00020% The whole indication blinks once.

(12) Setting of Hold Time for Bubble Retardant (FUNCTION " E ")

1. Select FUNCTION " E " in the PROGRAM1 mode. ⇒ 00030 (example of reading)
2. Press the [>] key. ⇒ 00030 The MSD blinks.
3. Using the [>] key, select a digit and then press the [∧] and [∨] keys to set the digit to the desired value. ⇒ 00050 Blinking shifts right, to the LSD, and then returns to the MSD.
4. Press the ENT key to confirm your setting. ⇒ 00050 The whole indication blinks once.

(13) Setting of Sampling Time for Bubble Retardant (FUNCTION " F ")

1. Select FUNCTION " F " in the PROGRAM1 mode. ⇒ 00030 (example of reading)
2. Press the [>] key. ⇒ 00030
3. Using the [>] key, select a digit and then press the [∧] and [∨] keys to set the digit to the desired value. ⇒ 00030 Blinking shifts right, to the LSD, and then returns to the MSD.
4. Press the ENT key to confirm your setting. ⇒ 00030 The whole indication blinks once.

(14) Auto-range Selection (FUNCTION " 1. ")

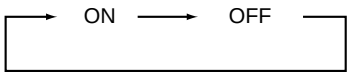
This function selects execution / stop of the auto-range switching function. The auto-range function automatically selects either output range 1, output range 2, or output range 3 depending on the measured values. For details on the function, see Subsection 5.2.1. In addition, the contact outputs (A1, A2, A3, and A4) operate corresponding to the selected output range.

Note: Confirm that the range 1, 2, or 3 setting satisfies the conditions in Section 6.6 (1). If the conditions are not satisfied, auto-range switching does not take place.

The following describes the setting key operations:

(Example of display)

1. Select FUNCTION " 1. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ OFF (stop)
2. Press the [>] key to select on / off. ⇒ ON (execution)



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3. Press the [ENT] key to enter the setting. ⇒ ON
   The display flashes once.

(15) Remote Range Selection (FUNCTION " 2. ")

This function sets execution/stop of the remote range switching function. However, if the auto-range switching function, item (11) above, is selected (execution), this setting is invalid. If execution of this function is set, either output range 1, output range 2, or output range 3 is selected by a contact input (R1, R2, or R3). Contact outputs (A1, A2, A3, and A4) operate by the selected output range. Table 6.10 shows the remote range switching operation.

The following is the procedure for this function:

Table 6.10 Remote Range Switching Operation

Contact input		Selected range	Range contacr output
R1 to R2	R1 to R3		
Open	Open	Output range 1	A1 to A2 : Closed
Closed	Open	Output range 2	A1 to A3 : Closed
Open	Closed	Output range 3	A1 to A4 : Closed

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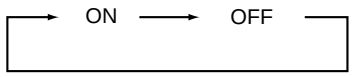
The following is the setting key operations:

(Example of display)

1. Select FUNCTION " 2. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ OFF (stop)
2. Press the [>] key to select on / off. ⇒ ON (execution)



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3. Press the [ENT] key to enter the setting. ⇒ ON
   The display flashes once.

(16) Local Range Setting (FUNCTION " 3. ")

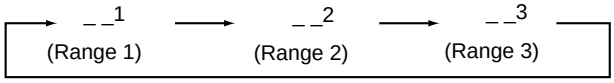
If automatic range switching and remote range switching are not selected, this function selects the output range. Contact outputs (A1, A2, A3, and A4) operate by the selected output range.

For the relationship between output ranges and contact outputs, see Table 6.10.

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " 3. " in the < PROGRAM1 > mode. The current set range is displayed with a code. ⇒ _ _1 (Range 1)
2. Press the [>] key to select the code. ⇒ _ _2 (Range 2)



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3. Press the [ENT] key to enter the setting. ⇒ _ _2 The display flashes once.

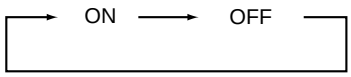
(17) Setting Output Hold in Maintenance (FUNCTION " 4. ")

This function sets execution/stop of output hold in maintenance (< MAINT. > or < PROGRAM1, 2 > mode). If " execution " is selected, the output value immediately before operation holds when the maintenance mode is selected.

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " 4. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ ON (execution)
2. Press the [>] key to select on / off. ⇒ OFF (stop)



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3. Press the [ENT] key to enter the setting. ⇒ OFF
   The display flashes once.

Immediately after setting, the setting status of the analog output becomes effective. When on (hold) is selected, the HOLD lamp is lit while the output is held. In addition, even if off (no-hold) is selected, FUNCTION " 5. " setting has priority provided that " _ _ 2 " (hold) or " _ _ 3 " (preset) is selected in the operation of FUNCTION " 5. " (the next item).

(18) Setting Output Mode If a Failure Occurs (FUNCTION " 5. ")

This function sets the analog output mode (no-hold, hold, or preset) if a failure occurs (the FAIL lamp is lit).

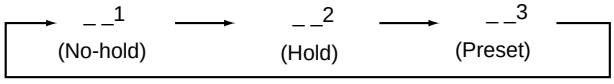
The operation details are as follows:

- No-hold: Even if a failure occurs, the analog output does not hold.
- Hold: When a failure occurs, the analog output immediately before the occurrence holds until the failure returns to normal.
- Preset: When a failure occurs, the analog output is held at a preset output value. The preset value is set with FUNCTION " 5 " described in this section (3).

The following describes the setting key operations:

(Example of display)

1. Select FUNCTION " 5. " in the < PROGRAM1 > ⇒ _ _1 (Non-hold) mode. The current set code is displayed.
2. Press the [>] key to select the setting code. ⇒ _ _2 (Hold)



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3. Press the [ENT] key to enter the set code. ⇒ _ _2
   The display flashes once,

In this function, if " _ _ 2 " (hold) or " _ _ 3 " (preset) is selected, this setting has priority over the setting in FUNCTION " 4. "

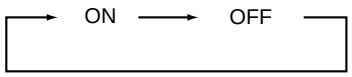
(19) Setting Output Hold for 4 mA or less (FUNCTION " 6. ")

By setting " on " (execution) in this function, the analog output does not fall below 4 mA (or 1 V).

The following describes the setting key operations:

(Example of display)

1. Select FUNCTION " 6. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ OFF (stop)
2. Press the [>] key to select on or off. ⇒ ON (execution)



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3. Press the [ENT] key to enter the setting ⇒ ON
   The display flashes once.

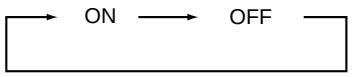
(20) Setting Negative Turbidity Display Hold (FUNCTION " 7. ")

When on (execution) is set in this function, the turbidity indication does not fall below 0.000 NTU even if the turbidity value becomes negative in the computation. However, this setting is effective only in the < MEAS. > mode.

The following describes the setting key operations:

(Example of display)

1. Select FUNCTION " 7. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ OFF (stop)
2. Press the [>] key to select on or off. ⇒ ON (execution)



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3. Press the [ENT] key to enter the setting ⇒ ON
   The display flashes once.

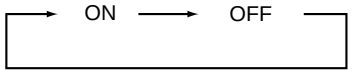
(21) Setting Display-hold in Automatic Cleaning and Calibration (FUNCTION " 8.")

When " ON (execution) " is selected in this function, a turbidity value immediately before the operation holds and displays during automatic cleaning and automatic zero calibration in < MEAS. > mode.

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " 8. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ OFF (stop)
2. Press the [>] key to select on or off. ⇒ ON (execution)



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3. Press the [ENT] key to enter the setting ⇒ ON
   The display flashes once.

(22) Selecting sampling specifications (automatic cleaning ,automatic zero calibration) (FUNCTION " 9. ")

Select sampling specifications.

Table 6.11 Sampling system and Settings

Sampling specification	Setting code
Without sampling system	_ _1
With sampling system without automatic cleaning and automatic zero calibration	_ _1
With sampling system and automatic cleaning	_ _2
With sampling system and automatic cleaning and calibration	_ _3

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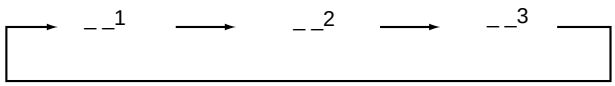
If a change is necessary, perform the key operations in the following procedure:

(Example of display)

1. Select FUNCTION " 9. " in the < PROGRAM1 > mode. The current set code is displayed. ⇒ _ _ 3
2. Press the [>] key to select the setting code. ⇒ _ _ 2



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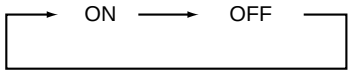
3. Press the [ENT] key to enter the setting. ⇒ _ _ 2
   The display flashes once.

(23) Selecting Execution / Stop of Automatic Cleaning Function (FUNCTION " A. ") [_ _ 2], [_ _ 3]

This function selects execution / stop of the automatic cleaning function (started with the internal timer) when the sampling system is added. If off (stop) is selected in the automatic cleaning function, the manual start operation in FUNCTION " 6 " in the < MAINT. > mode can be executed. As this function is set to on (execution) upon shipment from the factory, if it becomes necessary to select off (stop), perform the key operations in the following procedure:

(Example of display)

1. Select FUNCTION " A. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ ON (execution)
2. Press the [>] key to select on or off. ⇒ OFF (stop)



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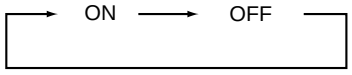
3. Press the [ENT] key to enter the setting ⇒ OFF
   The display flashes once.

(24) Selecting Execution / Stop of Automatic Calibration Function (FUNCTION " B. ")

This function selects execution / stop of the automatic calibration function (started with the internal timer) when the [_ _ 3] (sampling system) is tuned. If off (stop) is selected in the automatic calibration function, the manual start operation in FUNCTION " 7 " in the < MAINT. > mode can be executed. As this function is set to on (execution) upon shipment from the factory, if it becomes necessary to select off (stop), perform the key operations in the following procedure:

(Example of display)

1. Select FUNCTION " B. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ ON (execution)
2. Press the [>] key to select on or off. ⇒ OFF (stop)



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3. Press the [ENT] key to enter the setting ⇒ OFF
   The display flashes once.

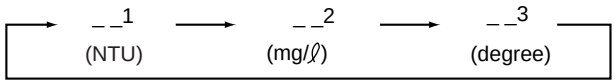
(25) Selecting Designation of Units (FUNCTION " C. ")

This function can set the unit of turbidity to be displayed on the converter at either " NTU ", " degree ", or " FTU ".

If the unit designation is to be changed, perform it using the following key operations:

(Example of display)

1. Select FUNCTION " C. " in the < PROGRAM1 > mode. The current set code is displayed. ⇒ _ _ 1 (NTU)
2. Press the [>] key to select the setting code. ⇒ _ _ 2 (mg/l)



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3. Press the [ENT] key to enter the setting. ⇒ _ _ 2
   The display flashes once.

The unit selected in step 3. is lit in the unit display area on the right of the data display when the turbidity is displayed (Figure 6.4).

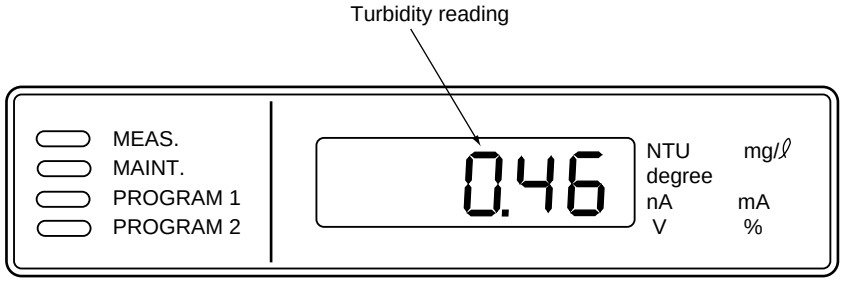

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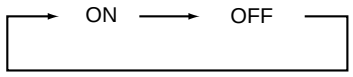
Figure 6.4 Unit Designation

(26) Selecting Calibration Plate/Standard Solution (FUNCTION " D. ")

In the span calibration operation for FUNCTION " 4 " in the < MAINT. > mode, this function sets either the calibration plate or the standard solution for span calibration. Upon shipment from the factory, on (calibration plate) is set. If off (standard solution) is to be selected, perform the key operations in the following procedure:

(Example of display)

1. Select FUNCTION " D. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ ON (calibration plate)
2. Press the [>] key to select on / off. ⇒ OFF (standard solution)



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3. Press the [ENT] key to enter the setting. ⇒ OFF
   The display flashes once.

(27) Selecting AUX (C1, C2) Contact Output (FUNCTION " E. ")

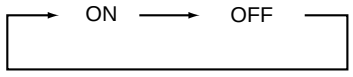
The operating conditions for AUX contact output (C1, C2) are selected from the following two:

- Upper and lower limit alarm contact output (setting: on)
- Contact output during automatic cleaning and automatic zero-calibration operations (setting: off)

The following shows the setting key operations:

(Example of display)

1. Select FUNCTION " E. " in the < PROGRAM1 > mode. The current set status is displayed. ⇒ ON
2. Press the [>] key to select on / off. ⇒ OFF



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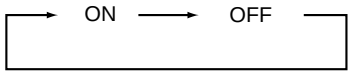
3. Press the [ENT] key to enter the setting ⇒ OFF
   The display flashes once.

(28) Setting for Execution of " Bubble Retardant " Option

1. Select FUNCTION " F. " in the PROGRAM1 mode.The display shows the current setting. ⇒ OFF
2. Press the [>] key to select between ⇒ ON



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3. Press the [ENT] key to confirm your selection. ⇒ ON
   The indication blinks once.

6.7 Operation in < PROGRAM2 > Mode

In this mode, the time setting operations for automatic cleaning and automatic zero calibration, the operation settings for contact output and the selection operations for part of execution/stop of the failure detection function are carried out.

- FUNCTION " 1 " to FUNCTION " F ": Time settings, contact output operation settings
- FUNCTION " 1 " to FUNCTION " F. ": Selection for part of execution/stop of the failure detection functions

Key operations made by specifying a function in the < PROGRAM2 > mode and the displays following those key operations are described in the following order:

(1) Time setting for automatic cleaning and automatic zero calibration

(2) Selection of contact output operation (open / close)

(3) Selection of execution/stop of the failure detection functions

(1) Time Setting for Automatic Cleaning and Automatic Zero Calibration (FUNCTION " 1 " to FUNCTION " A ")

Table 6.12 shows a list of setting times and operation functions. For details on automatic cleaning and automatic zero- calibration operations, see subsections 4.2.2 and 4.2.3. For specification without automatic cleaning or automatic zero calibration, this setting is non-operative.

Table 6.12 Time settings for Automatic Cleaning and Automatic zero Calibration

Setting	FUNCTION	Range of setting	Value upon shipment from factory
Automatic cleaning period	1	0.1 to 24.0 hours	0002.0
Cleaning calibration ratio (*3)	2	1 to 10 times	00001
Repeated cleanings	3	1 to 20 times	00005
Cleaning time 1 (*1)	4	10 to 120 seconds	00030
Cleaning time 2 (*2)	5	10 to 120 seconds	00030
Draining time 1 (*1)	6	10 to 120 seconds	00010
Draining time 2 (*2)	7	10 to 120 seconds	00010
Filling time 1 (*1)	8	10 to 120 seconds	00100
Filling time 2 (*2)	9	10 to 120 seconds	00100
Relaxation time	A	30 to 600 seconds	00150

(*1) For models without automatic zero calibration, use this time setting.
(*2) For the models with automatic zero calibration and automatic cleaning, use this time setting.
(*3) The time is set for the automatic cleaning period, while for the automatic zero-calibration period, the cleaning calibration ratio, which means the number of times automatic cleaning is performed for one automatic zero calibration, is set.

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The following shows an example of the setting operations for the automatic cleaning period. Similar operations apply to the other settings.

(Example of display)

1. Select FUNCTION " 1 " in the < PROGRAM2 > mode. The current setpoint is displayed. ⇒ 0002.0 (time)
2. Press the [>] key. ⇒ 0002.0 (time)
   The most significant digit flashes.
3. Select a digit with the [>] key and set the digit The flashing digit moves to the desired value using the [∧] or [∨] key. ⇒ 0004.0 (time)
   The right and when the least significant digit is reached, it returns to the most significant digit.
4. Press the [ENT] key. ⇒ 0004.0 (time)
   The entire display flashes once.

If the setpoint in step 4. is beyond the permissible range, " not " is displayed. Reset the message using the [>] key and repeat the operation from step 2.

(2) Selection of Contact Output Operation (open / closed) (FUNCTION " C " to FUNCTION " F ")

Select open or closed for the contact output when operated. Table 6.13 shows the types of contact outputs and corresponding functions.

Table 6.13 Contact Outputs and Operating Functions

Contact output	FUNCTION	Output terminal	Upon shipment f rom the factory
Maintenance contact output	C	M1, M2	Closed
FAIL contact output	D	F1, F2	Open
Upper and lower limit alarm contact output	E	C1, C2	Open
Contact output during automatic cleaning and automatic zero calibration	F	C1, C2	Closed

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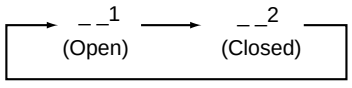
The following shows an example of the setting operations for the maintenance contact output. Similar operations apply to the other settings.

(Example of display)

1. Select FUNCTION " C " in the < PROGRAM2 > mode. The current set status is displayed. ⇒ _ _1 (Open)
2. Press the [>] key to select the setting codes ⇒ _ _2 (Closed)



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3. Press the [ENT] key to enter the setting. ⇒ _ _2
   The display flashes once,

(3) Selection of Execution / Stop of the Failure Detection Functions (FUNCTION " 1. " to FUNCTION " 9. ")

These functions can select execution/stop of part of the failure detection functions. Table 6.14 shows the detected failures and their operation functions.

Table 6.14 Detected Failures and Their Operation Functions

Detected failure	FUNCTION	Error code	Setting upon shipment from the factory
Turbidity overrange	1.	Err11	ON
Lamp disconnection	2.	Err12	ON
Lamp voltage failure	3.	Err13	ON
A/D circuit failure	4.	Err14	ON
Memory comparison failure	5.	Err15	ON
Reference voltage failure	6.	Err18	ON
Lamp service life	7.	Err25	ON
Automatic calibration failure	8.	Err26	ON
Upper or lower limit alarm	9.	MEAS lamp flashes.	ON

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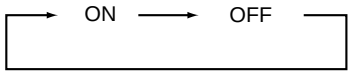
For details on each failure detection function, see Section 5.1. The following are the setting key operations for an example of turbidity overranging. The same procedure applies to the other settings.

(Example of display)

1. Select FUNCTION " 1. " to FUNCTION " 9. " in the < PROGRAM2 > mode. ⇒ ON (execution)
2. Press the [>] key to select on / off. ⇒ OFF (stop)



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3. Press the [ENT] key to enter the setting. ⇒ ON
   The display flashes once.

Note: Normally, it is not necessary to operate these.

6.8 Valve Operation

Table 6.15 shows the valve on/off statuses in measurement, draining, or zero calibration for each sampling specification. However, for operations in automatic cleaning or automatic zero calibration, see Section 4.2.

Table 6.15 Valve Statuses in Each Operation

Operation	Sampling specifications (set codes)	V1	V2	V3	V4	V5	SV1	SV2	SV3	SV4
Measurement	_ _1	Open	Open	Closed	Closed	Closed	–	–	–	–
	_ _2	Open	Open	Closed	Open	–	Closed	Closed	–	–
	_ _3	Open	Open	Open	Open	–	Closed	Closed	Open	Closed
Drain	_ _1	Closed	Open	Closed	Closed	Open	–	–	–	–
	_ _2	Closed	Open	Closed	Open	–	Open	Closed	–	–
	_ _3	Closed	Open	Open	Open	–	Open	Closed	Closed	Closed
Zero calibration (with " zero water ")	_ _1	Closed	Open	Open	Closed	Closed	–	–	–	–
	_ _2	Closed	Open	Open	Open	–	Closed	Closed	–	–
	_ _3	Open	Open	Open	Open	–	Closed	Closed	Closed	Open
Manual cleaning (measuring water)	_ _1	Open	Open	Closed	Open	Closed	–	–	–	–
	_ _2	Open	Open	Closed	Open	–	Closed	Open	–	–
	_ _3	Open	Open	Open	Open	–	Closed	Open	Open	Closed
Manual cleaning (" zero water ")	_ _1	Closed	Open	Open	Open	Closed	–	–	–	–
	_ _2	Closed	Open	Open	Open	–	Closed	Open	–	–
	_ _3	Open	Open	Open	Open	–	Closed	Open	Closed	Open

Note : Valves SV1 to SV4 are opened or closed with each [SV1] to [SV4] key in the < MAINT. > mode.

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7. MAINTENANCE

This chapter describes the inspection and maintenance implemented to maintain the instrument in good operating condition.

7.1 Items of Inspection and Maintenance and Their Periods

Table 7.1 shows the main inspection and maintenance items to maintain the instrument in good operating condition and their recommended periods before inspection or maintenance. As these periods vary with each operating condition, use Table 7.1 only as a guide.

Table 7.1 Guide for Inspection and Maintenance Periods

Inspection or maintenance item	Period between inspections or maintenance
Washing with cleaning water	On occasion
Cleaning of measuring cell	One week
Cleaning of deforming tank	One month
Lamp replacement	Half a year
Zero calibration	One month
Span calibration	One month
Cleaning of lenses	Half a year
Filter replacement	One year *1
Fuse replacement	One year
Cleaning of piping	Half a year
Checking of flowrate and water level	One month
Silicon tube in the case of pinch valve use	One year

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*1 : This is a guide for the replacement period if the meter is operated at a flowrate of 2 l/min using tap water having an average turbidity of 0.4 NTU.

7.2 Washing With Cleaning Water

For the specification without automatic cleaning, washing is carried out by opening and closing the valves manually.

For the specification with automatic cleaning , automatic cleaning (washing) is performed periodically.

For the automatic cleaning operation, see Subsection 4.2.2.

Here washing of the instrument with the specification without automatic cleaning is described.

In this case, washing is carried out by manually operating valve V4 for cleaning.

1. Select the < MAINT. > mode.
2. Open valve V4 and wash for about 30 seconds (for the statuses of each valve during washing, see Table 6.15). In order to prevent cleaning water from splashing, wash by passing measuring water or " zero water " through the valve.
3. Close valve V4 and open valve V5 for about 10 seconds to drain water.
4. Repeat steps 2 and 3 several times depending on the degree of contamination. 5. Finished.
5. Close valve V5

Note : This function is available when a cleaning water pipe is connected to the side of measuring cell.Cleaning of measuring cell is necessary ,see Section 7.3. for the details.

7.3 Cleaning of Measuring Cell

Clean the inside of the detector directly with a brush or the like.

1. Select the < MAINT. > mode.
2. Select the draining status (for the statuses of each valve during draining, see Table 6.15).
3. Loosen screw A under the detector cover and open the cover (see Figure 7.1).
4. After the water in the detector is drained off, wipe the inside of the detector with a soft brush, sponge, or the like. Be careful not to mar or scratch the inside and not to splash the lenses in the light source and light-receiving part with water.
5. Open valves V4 and SV2 to supply cleaning water and discharge the dirt with the water. Also in this case, gradually open valve V4 so as not to splash the lenses in the light source and light-receiving part with water.
6. Tighten screw A after cleaning is completed and execute zero and span calibrations.
7. Finished.

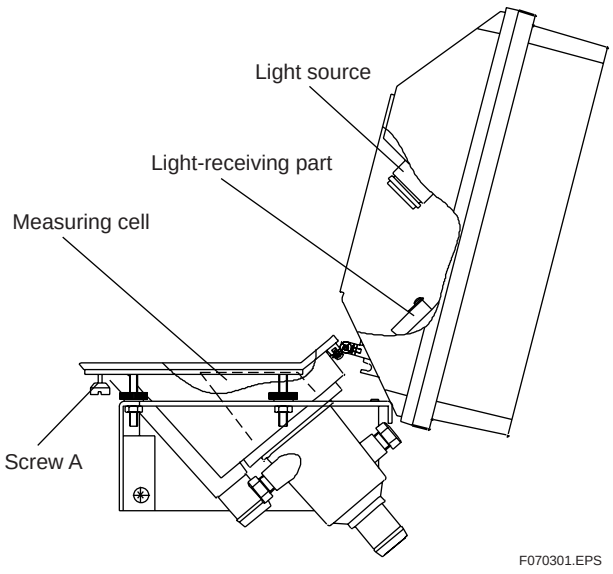
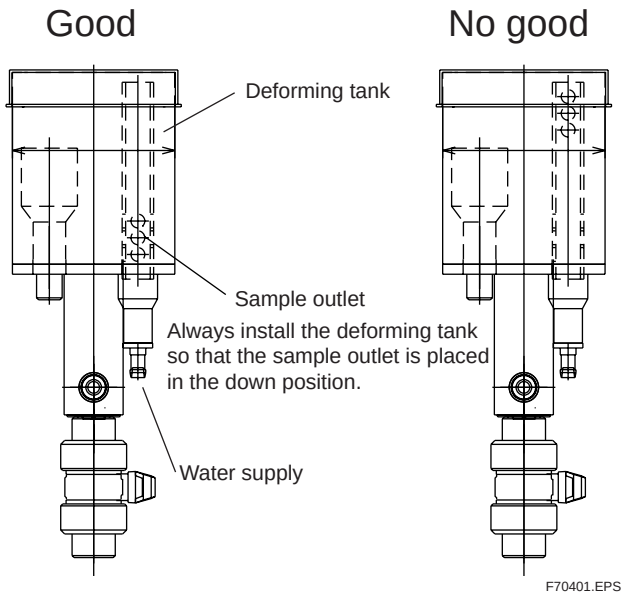


Figure 7.1 Detector

7.4 Cleaning of Deforming Tank

This section describes the cleaning of the deforming tank.

1. Select the < MAINT. > mode.
2. Open the valves so they are set to drain the tank. For the statuses of each valve in draining, see Table 6.15.
3. After the water in the deforming tank is drained off, open the uppers cover and wipe the inside of the tank with a soft brush, sponge, or the like.
4. After cleaning is completed, discharge any remaining dirt by supplying tap water or repeat filling the tank two or three times with “ zero water ” and then draining it until all of the dirt in the deforming tank is discharged with the water.
5. Finished



Note

After cleaning the deforming tank, be sure to restore the deforming tank so that the sample outlet is placed in the down position. Otherwise, bubbles are easy to generate..

7.5 Lamp Replacement

The lamp's service life is more than half a year. However, it is recommended that it be replaced with a new one after a period of half a year as preventive maintenance. Some lamp's life may be within half a year.

This section describes replacement of the lamp.

1. Turn off the power switch.
2. Remove the four C screws in the upper part of the detector and remove the cover (see Figure 7.2).
3. Disconnect terminals P1 and P2 by removing them from the terminal board and remove the two B screws, then remove the lamp holder.
4. Loosen the clamp that locks the lamp.
5. Replace the lamp. In doing this, confirm that the boss of the new lamp is placed in the position shown in Figure 7.2.

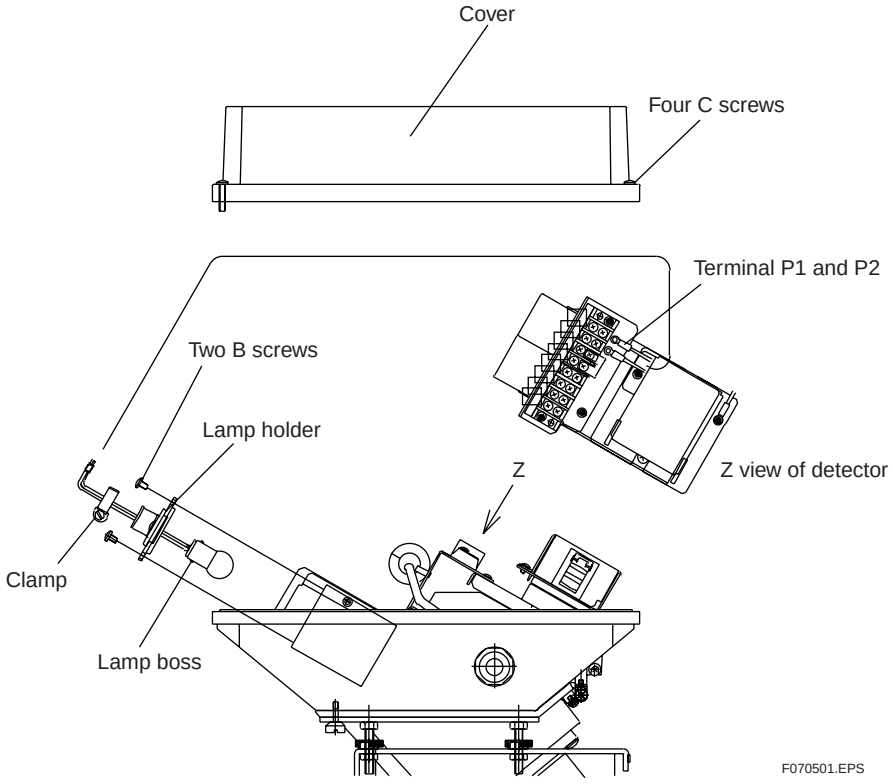


Figure 7.2 Lamp Replacement

6. Temporarily fix the clamp by tightening it slightly (to allow for later adjustment).
7. Clean the lens from above (i.e., the lamp side) using an alcohol-soaked applicator.
8. Securely fix terminals P1 and P2 on the terminal board and firmly tighten the two screws marked 'B.'
9. Turn on the power and wait at least five minutes for the lamp brightness to stabilize.
10. Carry out calibration for the setting of a reference voltage for lamp control.

    Select FUNCTION " C " in the MAINT. mode.

11. Press the ENT key. The converter shows the reference-signal voltage and the lamp voltage is fixed at approximately 4.9 V.

12. Slowly move the lamp up and down along the holder while measuring the reference-signal voltage on the display panel. Fix the clamp in the position where the maximum reading of the voltage is displayed within 0.6 to 2.3 V DC. Normally, the maximum lies somewhere between 70 mV and 140 mV, though it does vary more or less depending on the lot in which the plate is manufactured. The output level becomes higher as the turbidity setpoint of the calibration plate increases. Fasten the clamp at a tightening torque of 0.7 N•m, using a screwdriver if necessary. If the torque is less than that value, the lamp may move when the cover is opened or closed.

Note : It does not matter if the clamp is fastened more tightly using a regular flat-blade screwdriver.

As a general procedure to adjust lamp position, bring the pinhole for emitting light into the reference device close to the middle of the light beam. This increases the amount of light and thereby raises the voltage. Check again that the clamp is securely fastened.

13. Attach the cover and tighten the four screws marked 'C.'
14. Allow the turbidimeter to warm up for at least one hour. Then, press the ENT key when the reading stabilizes to update the reference setpoint for lamp control. If you change the mode during this procedure by pressing the FUNC key, for example, the updating will not come to a normal end. If the mode needs to be changed, press the ENT key prior to the change. When you have finished updating the reference setpoint for lamp control, follow steps 11 and 12 discussed earlier. Next, wait at least 30 minutes to allow the turbidimeter to stabilize and then press the ENT key.

15. Lamp replacement is now complete.

Wait at least 10 minutes to allow the lamp voltage to stabilize to approximately 4.9 V, and then carry out zero calibration described in Section 7.6 Zero Calibration and span calibration (using the calibration plate) described in 7.7 Span Calibration.

7.6 Zero Calibration

7.6.1 Zero Calibration with " Zero Water "

Zero calibration using " zero water " is described in this subsection.

(1) For specification with automatic cleaning and automatic zero calibration See 2.8.3

Carry out zero calibration using the manual start functions of automatic zero calibration.

1. Select FUNCTION " 7 " in the < MAINT, > mode. ⇒ " A.CAL " is displayed.
2. Press the [ENT] key. ⇒ Automatic zero calibration starts and the " CAL " lamp flashes.
3. Predetermined calibration operations are performed and terminated.

(2) For specification with automatic cleaning but without automatic zero calibration See 2.8.2

Carry out zero calibration by allowing " zero water " to flow for about 30 minutes after performing cleaning with the manual start function of automatic cleaning.

1. Select FUNCTION " 6 " in the < MAINT. > mode. ⇒ " JEt " is displayed.
2. Press the [ENT] key. ⇒ Automatic cleaning starts.
3. After cleaning is completed, allow " zero water " to flow for about 30 minutes to run-in the filter. (For valve statuses, see Table 6.15.)
4. Select FUNCTION " 1 " in the < MAINT. > mode. ⇒ " Turbidity value " is displayed.
5. Wait until the reading becomes stable and then press the [ENT], [>], and [ENT] keys in this order to calibrate the meter.
6. Finished.

(3) For specification without automatic cleaning or automatic zero calibration See 2.8.1

After performing manual cleaning, allow " zero water " to flow for about 30 minutes to perform zero calibration.

1. Select the < MAINT. > mode and open the valves so they are set to drain (for valve statuses, see Table 6.15).
2. After draining off the measuring water, allow " zero water " to flow (for valve statuses, see Table 6.15).
3. Open valve V4 with " zero water " flowing and let cleaning water flow for about 30 seconds.
4. Close valve V4 and open valve V5 to drain off the water.
5. Close valve V5 after about 10 seconds.
6. Repeat operation steps 3 to 5 several times depending on the degree of contamination.
7. Let " zero water " flow for about 30 minutes to run-in the filter.
8. Select FUNCTION " 1 " in the < MAINT. > mode.
9. " Turbidity value " is displayed.
10. Wait until the reading becomes stable and then press the [ENT], [>], and [ENT] keys in this order to calibrate the meter.
11. Finished.

7.6.2 Zero Calibration by Turning Off Light Source

If the turbidity to be measured is 200NTU or more, zero calibration can be performed by turning OFF the light source.

The zero-point difference between this method and the " zero water " method is about 1 NTU or less.

1. Select FUNCTION " 2 " in the < MAINT. > mode. ⇒ " Turbidity value " is displayed.
2. The lamp goes out when the [ENT] key is pressed once.
3. Wait one minute or more until the reading becomes stable, and then press the [>] and [ENT] keys in this order, Now calibration is over.
4. Finished.

7.7 Span Calibration

7.7.1 Span Calibration Using Calibration Plate

In normal maintenance, carry out span calibration using the attached calibration plate. The calibration plate is calibrated by the standard solution.

1. Select FUNCTION " D. " in the < PROGRAM1 > mode and confirm that " ON " is displayed. " ON " means calibration using the calibration plate (" ON " is set up upon shipment from the factory).
2. Select FUNCTION " 4 " in the < MAINT, > mode.⇒ " Turbidity value " is displayed.
3. Drain the measuring water in the detector (for the valve statuses when draining, see Table 6.15).
4. Loosen screw A under the detector cover and open the detector (see Figure 7.3).
5. Set the calibration plate housed in the upper inside part of the converter as shown in Figure 7.3. If the calibration plate is dirty, wipe the part of its surface used for light scattering (the glossy part in the center of the plate) with the attached silicone cloth. In doing this, take care not to scratch the surface. Also, do not clean it with a solvent such as alcohol (but clean it with a detergent).
6. Shut the detector and tighten screw A.
7. Wait until the reading becomes stable and press the [ENT], [>], and [ENT] keys in this order. Now calibration is over.
8. Open the detector again and remove the calibration plate and then shut the detector and tighten screw A.
9. Take care not to let the calibration plate get dirty; house it in the converter.
10. Finished.

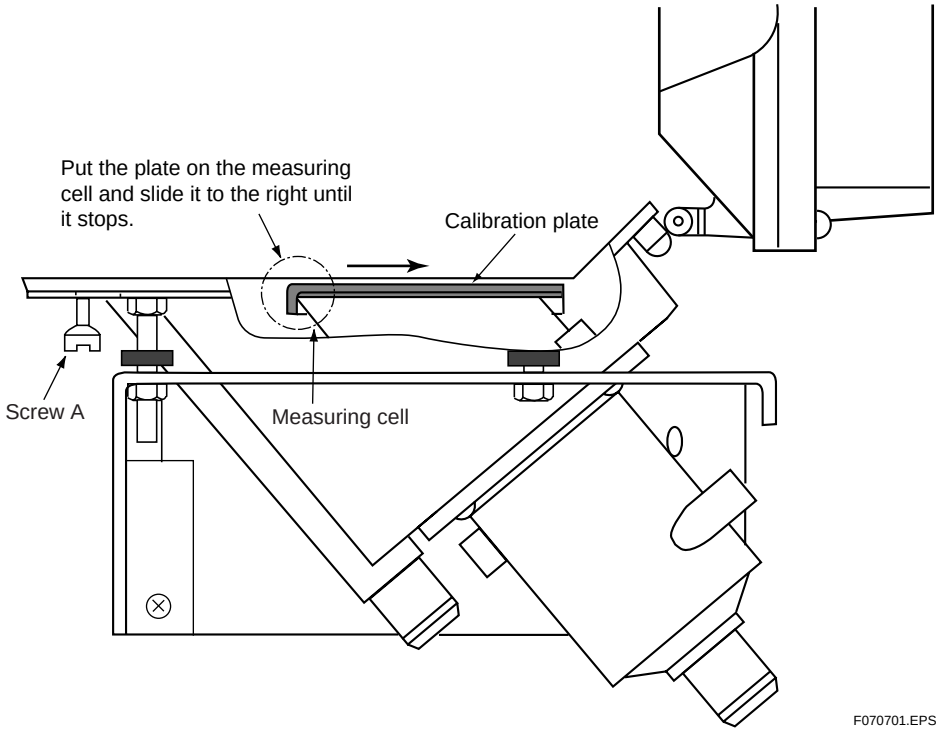

Put the plate on the measuring cell and slide it to the right until it stops.
Calibration plate
Screw A
Measuring cell
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Figure 7.3 Setting Calibration Plate

< Cleaning Procedure for the Calibration Plate >

Dust and dirt on the surface of the calibration plate should be cleaned in the following procedure:

(1) Wiping with the attached cloth or cleaning by washing

If there is dust on the surface, remove it in a manner of lightly wiping with the attached cloth. Do not, in this case, rub hard on the surface.

If dust or dirt is not removed merely by wiping, wash the surface letting tap water flow on the surface. After cleaning, drain off the water, and wipe up the remaining water with the attached cloth or tissue. In doing this, do not rub the surface.

(2) Cleaning with detergent

If dirt is stuck on the surface through contact with your hand, or dirt cannot be removed even with wiping as described in (1), clean the plate with a detergent. Cleaning should be done in the following procedure:

1. Dissolve a suitable quantity of detergent in a certain amount of tap water and immerse the calibration plate in the solution.
2. Swirl the calibration plate around in the solution to remove the dirt from the surface.
3. If the dirt cannot be removed only by swirling the plate around, wipe the surface lightly with tissue that has been dampened in the solution to remove dirt.
4. After dirt has been removed, thoroughly rinse off the solution using tap water and drain off well the water droplets remaining on the surface.
5. Wipe up the remaining water with the attached cloth or tissue. In doing this, do not rub the surface.

CAUTION

- Avoid rubbing the surface with any material.
- For cleaning, do not use agents other than a detergent (e.g., a solvent such as ethanol, acetone, etc.).
- For cleaning, also avoid touching the surface with your fingers.
- If the surface gets scratched, a correct turbidity reading cannot be obtained. Be sure to exercise care in handling.

7.7.2 Span Calibration Using Standard Solution

Span calibration is carried out normally with the calibration plate. However, if the standard solution is to be used, do it in the following procedure:

1. Prepare 10 liters or more of the standard solutions (see Subsection 7.15).
2. Select FUNCTION " D. " in the < PROGRAM1 > mode and change the setting to " OFF ". " OFF " means calibration with the standard solution (" ON " is set upon shipment from the factory).
3. Select FUNCTION " 4 " in the < MAINT. > mode.⇒ " Turbidity value " is displayed.
4. Stop supplying the measuring water and once drain the measuring water into the detector. (see Table 6.15).
5. Drain several times using " zero water " and remove the dirt on the detector and deforming tank. Finally, stop the " zero water " and drain off the detector and the deforming tank so that no water remains in them.
6. Connect the standard solution tank to the measuring water feed inlet and supply the standard solution at 2 l/min using a pump. Supply the standard solution agitating it with a magnetic stirrer.
7. When the standard solution begins to overflow the measuring cell, stop supplying the standard solution by turning off the pump, and drain it off by opening the drain valve. Then close the drain valve and again supply the standard solution.
8. Allow the standard solution to flow for 4 minutes or more and after the reading stabilizes, carry out span calibration. For the operating procedure, see Section 6.5 (4).
9. After calibration is completed, stop supplying the standard solution and drain it. Reconnect the measuring water piping and restart the supply of measuring water. It takes a certain time until the detector, deforming tank, and piping are completely filled with new measuring water.
10. Select FUNCTION " D. " in the < PROGRAM1 > mode and return the setting to " ON."
11. Finished.

7.8 Cleaning of Lenses

1. Cleaning of Lenses Select the < MAINT. > mode and turn off the power switch.
2. Loosen screw A under the detector cover and open the detector (see Figure 7.4).
3. Check whether or not the lenses in the detector (see Figure 7 .4) are dirty. If they are, wipe them using, e.g., an applicator. In this case, it is better to soak the applicator in alcohol.
4. After cleaning the lenses, carry out zero and span calibrations.
5. Finished.

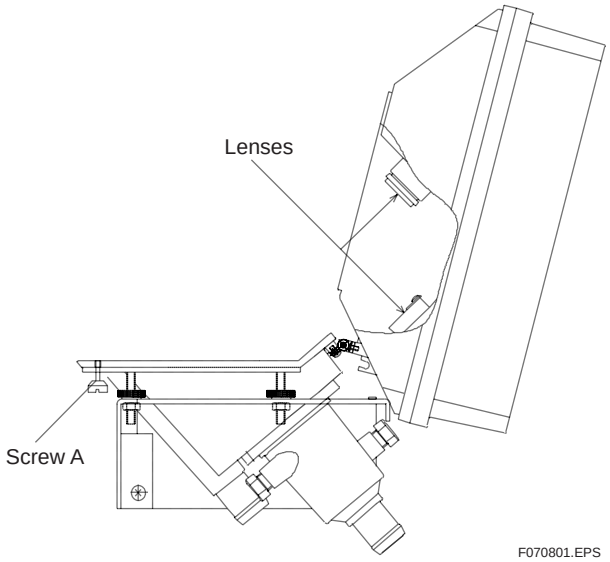

Figure 7.4 Lens Positions

7.9 Replacement of Filter (for “ zero water ”)

If the filter employs an element for “ zero water ”, replace it periodically.

1. Select the < MAINT. > mode.
2. Shut valves V2 and V3.
3. Turn the filter case to remove it. (Exercise care because water inside the case may spill out.)
4. Wipe the inside wall of the case with a brush or the like if it is dirty.
5. Replace the filter element with a new one.

   In this case, be sure that the O-ring for preventing water leakage is not bitten.
6. Reassemble the filter in the reverse order of disassembly.
7. Open valves V2 and V3, let “ zero water ” flow and check whether or not any water leaks out.
8. Loosen the knob of the air vent at the top of the filter and vent the air until tap water begins to leak out. After the air venting is completed, tighten the knob.
9. Allow water to flow for 20 minutes or more to run-in the filter.
10. Finished.

Note : If the zero filters is not to be used for a prolonged time, remove the filter and dry and store it in a dry place.

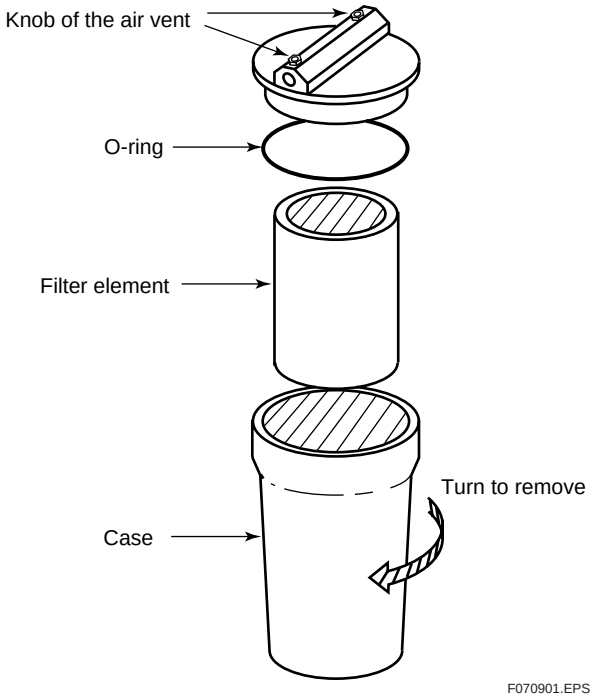

Figure 7.5 Replacement of Zero Filter

7.10 Replacement of Fuses

For preventive maintenance, it is recommended that the fuses be replaced each with a new one after a period of one year.

As there are both 1 A and 3 A fuses, do not mix them up.

1. Turn off the power switch.
2. Remove the caps of the fuse holders on the front panel of the converter (turn counterclockwise) (see Figure 7.6).
3. Replace the fuses.
4. Close the caps; now the procedure is completed.

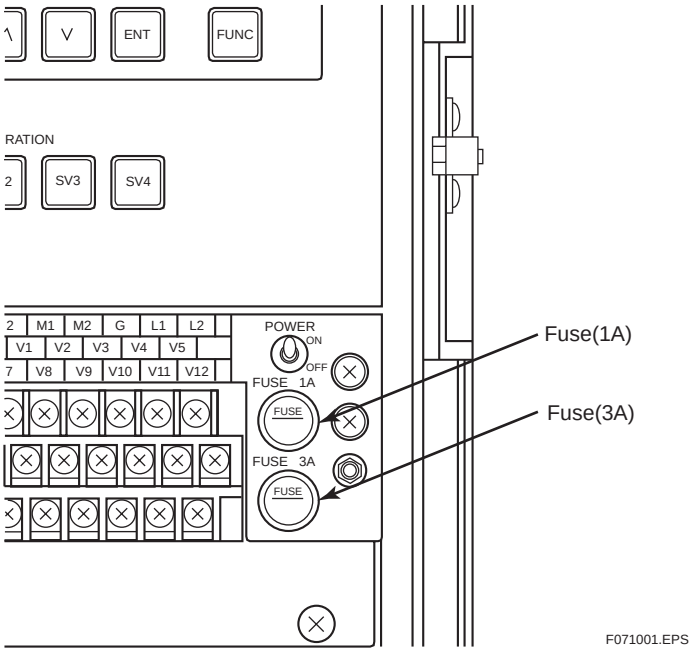

Figure 7.6 Replacement of Fuses

7.11 Cleaning of Piping

Remove the piping between the detector and the deforming tank and clean it.

1. Select the < MAINT. > mode.
2. Set the meter to drain (for the valve statuses in draining, see Table 6.15).
3. After confirming that the water in the deforming tank is drained off, remove the piping between the detector and the deforming tank, remove the dirt on the inside wall of the piping with a slender brush or the like, and last wash out the inside of the piping with tap water.
4. Attach the piping again in the reverse order of removal.
5. Finished.

7.12 Checking Flowrate (Water Level)

Check the water level of the measuring cell by letting measuring water or “ zero water ” flows.

1. Select the < MAINT. > mode . Remove screw A under the detector cover to open the detector (see Figure 7.1). Let each valve be set in the measuring status or the zero calibration status (see Table 6.15).
2. Confirm that the measuring surface is like a mirror finish and, if the surface is rippled, adjust the flowrate of the measuring water or “ zero water ”.
3. Check the situation for dirt inside the detector and if is dirty, clean it. If cleaning is performed, be sure to calibrate zero and span.
4. Checking is finished by closing the detector.
5. Finish

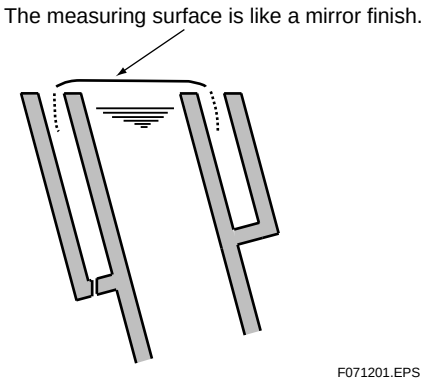

Figure 7.7 Measuring Water Surface

7.13 Operation If Water Supply is Suspended

If the supply of measuring water and tap water (cleaning water and “ zero water ”) is suspended, normal measurements cannot be carried out. The instrument cannot detect a suspension of measuring water and tap water (cleaning water and “ zero water ”). Thus, check the water supply status regularly.

An automatic calibration failure (Err26) or an upper or lower limit alarm may be detected during an interruption in the supply of measuring water and tap water (cleaning water and “ zero water ”). If such a failure is detected, check the supply of measuring water and/or tap water.

7.14 Operation During Power Failure and at Power Recovery

Setting data are stored in the EEPROM (non-volatile memory). Accordingly, data are not lost in a power failure. In addition, the current operation mode and function number are saved in the RAM and backed up for about 30 to 60 minutes.

Hence, if the power supply to the converter is temporarily suspended, the operation mode and function number status immediately before the power is turned off are retained unchanged as long as the re-supply of current is performed within the backup period. However, operations in the way of execution cannot be recovered and the initial status is restored in that function number.

If the backup time elapses, the status of FUNCTION " 1 " (turbidity display) in the < MEAS. > mode is set when the power is recovered.

If the power fails in the < MEAS. > mode, the internal timer is reset upon power recovery. Thus, automatic cleaning and automatic zero calibration operations start to operate at the measurement start point in Figure 7.8.

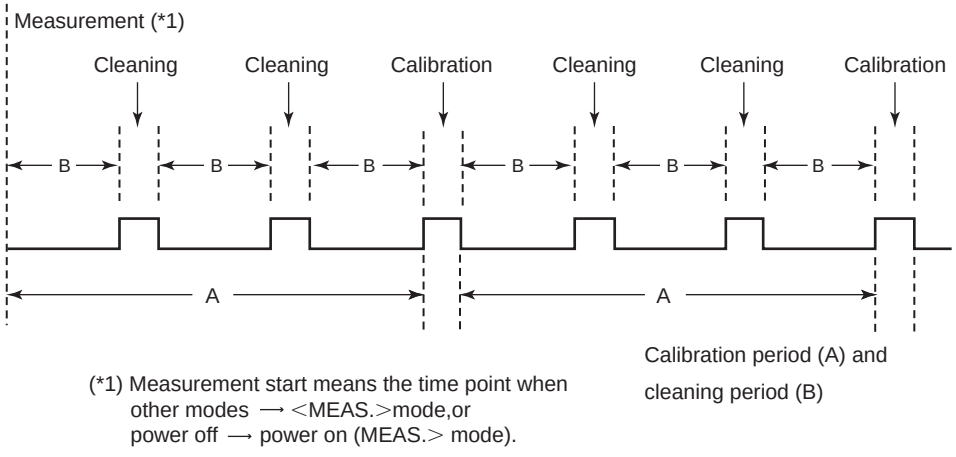

Figure 7.8 Automatic Cleaning and Automatic Zero Calibration Periods

If the power fails, valves SV1 and SV3 (monitor valves) retain the status before the power was turned off (open or closed). Note that, even if the power fails, they may not necessarily be closed. Valves SV2 and SV4 (solenoid valves) are shut.

The contact statuses are as shown in Table 7.2.

Table 7.2 Contact Operation in Power Failure

Contact output	Terminals	Operation
Maintenance output	M1,M2	Closed
FALI output	F1,F2	Open
AUX output	C1,C2	Closed
Range output	A1,A2	Closed
	A1,A3	Open
	A1,A4	Open

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7.15 Standard Formazine Solution

The formazine solution used for calibrations must be prepared by diluting the 4000-NTU standard formazine solution. The following shows how to prepare the 4000-NTU standard formazine solution and reference formazine solution for span calibrations.

7.15.1 Preparing 400-NTU Standard Formazine Solution

(1) Reagents Used

- Hydrazinesulfate [$(NH_2)_2 \cdot H_2SO_4$]
- Hexamethylenetetramine [$(CH_2)_6 \cdot N_4$]

(2) Apparatuses Used

- Two 1-L measuring beakers
- One 2-L measuring flask
- One balance

(3) Preparation Procedure

- Measure 1.000 ± 0.01 g of hydrazinesulfate using the balance, and pour in approximately 700 ml of distilled water to dissolve it (to make liquid A).
- Measure 100.00 ± 0.01 g of hexamethylenetetramine using the balance, and pour in approximately 700 ml of distilled water to dissolve it (to make liquid B).
- Confirm that the substances in liquids A and B are completely dissolved. After that, mix them together in a two-liter measuring flask and add distilled water to make the total solution equal to 2 liters.
- Leave this solution untouched for 48 hours at 25degC± 3degC.

By diluting this 4000-NTU standard formazine solution with distilled water, you can obtain a standard formazine solution with the required turbidity. Note that a standard 4000-NTU formazine solution is valid for use for one month. You need to record the date of its preparation.

7.15.2 Preparing Standard Formazine Solution for Calibration

To prepare a standard formazine solution for calibration, dilute the 4000-NTU standard formazine solution according to the procedure below.

(1) Precautions

- Use clean glass apparatuses and perform accurate measurements.
- For the dilution liquid, use distillated water or water filtrated by a 1-micron micro filter.
- Thoroughly mix the 4000-NTU standard formazine solution before sampling it for dilution.

(2) Procedure for Preparing 20 Liters of Standard Formazine Solution for Calibration

- 100-NTU standard solution: Measure 500 mL of 4000-NTU standard formazine solution, and add dilution liquid to make the total quantity to 20 L.
- 50-NTU standard solution: Measure 250 mL of 4000-NTU standard formazine solution, and add dilution liquid to make the total quantity to 20 L.
- 20-NTU standard solution: Measure 100 mL of 4000-NTU standard formazine solution, and add dilution liquid to make the total quantity to 20 L.
- 10-NTU standard solution: Measure 50 mL of 4000-NTU standard formazine solution, and add dilution liquid to make the total quantity to 20 L.

8. TROUBLESHOOTING

If a failure occurs in the converter or the detector, the self-diagnostic function detects the failure and lights up FAIL lamp to notify of the occurrence of the failure. Details on the failure can be known by the " error number checking operation ". When the FAIL lamp is lit, first check the error number and then do the checks according to each item described in Section 8.1.

Improper indications that cannot be checked by the self-diagnostic function may also be considered. If an indication failure occurs but the FAIL lamp is not lit, do the checks referring to each item in Section 8.2. For checking, prepare a multimeter, or the like, that can measure DC / AC voltages, DC currents, and resistances.

As a result, if component replacement or repair is required, or if the location of the failure cannot be determined, contact Yokogawa Electric.

8.1 Events in Which FAIL Lamp Is Lit

If the FAIL lamp is lit during measurement, check the error number in the following procedure and carry out making checks corresponding to each number.

< Error Number Confirmation Procedure >

1) Select FUNCTION " A " in the < MAINT. > mode and press the [ENT] key.
2) A display appears, such as " Err11 ". Check the failure parts according to the checking procedure for each error number.

(Note 1) When a failure occurs, the FAIL contact operates. If the FAIL status presents an inconvenience, perform an " error reset operation " (FUNCTION " B " in the < MAINT. > mode) to reset the failure. If resetting, be sure to first check the details by the " error number checking operation " before resetting.

(1) Err11 (turbidity overrange) Occurrence

Carry out checking in the following order:

Operation and checking procedure	Failure section and disposition
1) Measure the DC voltage across the converter connection terminals [S1 (+) and AG (-)] to make sure of it, and confirm that it is smaller than - 2.45 V or larger than +0.5V.	
2) Check whether or not the turbidity of measuring water exceeds the measurable range (2200 NTU).	a) " Err11 " is detected when the turbidity of the measuring water increases and the detector signal exceeds -2.45 V.
3) Measure the DC voltage across the converter connection terminals [V + (+) and AG (-)] and confirm that it is + 5 ±60.5 V.	b) If the measured voltage is out of the range, a failure of the + 5 V power circuit on the converter analog board is assumed. ⇒ Request inspection and / or repair of the analog board.
4) Measure the DC voltage across the converter connection terminals [V - (+) and AG (-)] and confirm that it is - 5 ± 0.5 V.	c) If the measured voltage is out of the range, a failure of the - 5 V power circuit on the converter analog board is assulned. ⇒ Request inspection and / or repair of the analog board.
5) Introduce the external light onto the scattered-light-receiving element by opening the detector and check whether the DC voltage across the converter connection terminals [S1 (+) and AG (-)] changes.	d) If the measured voltage does not change, a failure of the detector preamplifier is assumed. ⇒ Request inspection and / or repair of the measuring preamplifier.

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(2) Err12 (lamp disconnection) Occurrence

Carry out checking in the following order:

Operation and checking procedure	Failure section and disposition
1) Open the upper cover of the detector and confirm whether the lamp is lit.	a) If it is not lit, a loosening of the P1 and P2 converter and detector connection terminal screws is assumed . ⇒ Tighten them again securely.
2) If there is no problem with the terminal screws being loose, disconnect the wiring to converter connection terminals P1 and P2, and measure the resistance between detector connection terminals P1 and P2.	b) If the resistance goes to infinity, it shows the lamp filament has burned through. ⇒ Replace the lamp with the spare lamp as an accessory. ⇒ After replacing the lamp, perform " lamp control reference value calibration " and " span calibration."
3) If the lamp is lit, measure the DC voltage across the converter connection terminals [S2 (+) and AG (-)].	c) If the measured voltage is within ±0.5 V, a failure of the lamp light quantity control receiving element is assumed. ⇒ Request checking and / or repair of the control preamplifier.

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(3) Err13 (Iamp voltage failure) Occurrence

Carry out checking in the following order:

Operation and checking procedure	Failure section and disposition
1) Measure the DC voltage across the converter connection terminals [P1 (+) and P2 (-)] and confirm that it exceeds the range of + 3 to + 6 V.	
2) Check for shortcircuiting between the converter and detector connection terminals P1 and P2.	a) As the lamp power supply circuit has the function of overcurrent protection, if shortcircuiting is eliminated, the lamp voltage is restored by itself.
3) Check for loosening of the primary and secondary connectors (CN7 and CN8) of the lamp power transformer in the converter.	b) If there is loosening due to poor contact, the lamp voltage is restored by itself by re-inserting the connectors. c) If there are no problems in checking a) and b), a failure of the lamp power supply circuit on the converter analog board is assumed. ⇒ Request checking and / or repair of the analog board.

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(4) Err14 (A / D circuit failure) Occurrence

A failure of the A / D conversion IC or the measurement and comparison input circuits is assumed. Request checking and/or repair of the converter analog board.

(5) Err15 (memory comparison failure)

Occurrence A data memory IC (EEPROM) failure is assumed. Request checking and/or repair of the converter CPU board

CAUTION

If the power is turned off with a memory-comparison failure generated, the stored data are initialized when the power is turned on again. If initialization is performed, re-setting of necessary data, zero and span calibration for the input circuit, Iamp control reference value calibration, and turbidity zero and span calibration are required. If data cannot be properly written into the memory, " Err17 " is displayed to notify of a failure occurrence.

(6) Err16 (RAM failure) Occurrence

A failure of the IC (RAM) used for the computation buffer is assumed.

Request checking and / or repair of the converter CPU board.

Note : Err16 is detected only when the power is turned on. All functions of the converter are suspended when a failure occurs.

(7) Err17 (EEPROM failure) Occurrence

A failure of the data memory IC (EEPROM) is assumed.

Request checking and/or repair of the converter CPU board.

Note : Err17 is detected only when the power is turned on. All functions of the converter are suspended when a fanure occurs.

(8) Err18 (reference signal voltage failure) Occurrence

Operation and checking procedure	Failure section and disposition
1) Measure the DC voltage across the converter connection terminals [S2 (+) and AG (-)]. Confrrm that it is lower than about - 2.45 V or it is higher than +0.5V.	a) A failure of the control preamplifier in the converter is assumed. ⇒ Request checking and / or repair of the control preamplifier.

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(9) Err25 (Iamp service life ended) Occurrence

Operation and checking procedure	Failure section and disposition
1) Measure the DC voltage across the converter connection terminals [P1 (+) and P2 (-)]. Confirm that it is about 5.4 V.	a) The lamp brightness decreases and the lamp voltage shows the upper control limit (about 5.4 V). ⇒ Replace the lamp with the spare lamp .

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Note : If the lamp life alarm occurs, turbidity measurement does not immediately become impossible. If the lamp life alarm occurs, since the lamp voltage is fixed at about 5.4 V, turbidity measurement can be continued in this state. However, since the lamp voltage is not controlled, measurement error gradually increases. Thus, replace the lamp as soon as possible.

CAUTION

After replacing the lamp, perform running-in for an hour or more and then carry out lamp control reference value calibration and turbidity span calibration.

(10) Err26 (automatic calibration failure) Occurrence

Operation and checking procedure	Failure section and disposition
1) Select the < MAINT. > mode and check the open/shut operations by turning valves SV 1 and SV3 on and off.	
2) If the valve (s) does (do) not operate properly, turn off the power to the converter one time and remove the motor-operated valve wiring from the converter connection terminal board (Table 8.1).	
3) Turn on the power again and check whether the valve driving voltage (power voltage) appears across the terminals by doing an onloff operation using the SV key (Table 8.1).	a) If the normal driving voltage is not output, a failure of the valve driving circuit on the converter analog board is assumed. ⇒ Request checking and/or repair of the analog board. b) If the normal driving voltage is output, a failure of the motor-operated valve (s) is assumed. ⇒ Replace the motor-operated valve (s) with good one (s).

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Table 8.1 Motor-operated Valve Connection Terminals

Terminal	Valve	Function
V1 V2 V3	SV1 (Pinch valve)	Open,closed – COM
V4 V5 V6	SV3 (Motor operated valve)	Open Closed COM

<Example of operation>

SV1 open ⇒ Across V1 and V3: Power supply voltage output
SV1 closed Across V1 and V3: 0 V output
SV3 open ⇒ Across V4 and V6: Power supply voltage output
Across V5 and V6: 0 V output
SV3 closed ⇒ Across V4 and V6: 0 V output
Across V5 and V6: Power supply voltage output

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(11) FAIL Lamp Is Lit and Other Lamps and Displays Are All Off

This shows a CPU failure occurrence . For confirmation, turn off the power one time and then turn it on again. If the CPU fails, the FAIL Iamp immediately lightts up. After confirmation, request checking and/or repair of the CPU board.

8.2 FAIL Lamp Not Lit

If an indication failure occurs that the self-diagnostic function cannot detect, check it by referring to Table 8.2.

Table 8.2 Phenomena for Failures and their Causes and Countermeasures

Phenomenon for failure	Estimated cause	Checking and disposition
a) Turbidity reading does not change.	1) Failure of the measuring light-receiving element in the detector	Conform the reading using the calibration plate. If there is no change, a failure of the measuring preamplifier in the detector is assumed. Request checking and/or repair.
	2) Clogging in the piping between the detector and the defoaming tank	Open the detector and, if measuring water does not flow through the measuring cell, check the piping and clean it if there is clogging.
	3) If the turbidity reading is fixed to 0.00 NTU and thus does not change, it is assumed that 0.00 NTU was entered in reference sensitivity calibration.	Carry out reference sensitivity calibration using the calibration plate.
b) Fluctuation of turbidity reading is large.	1) Unsuitable measuring water flowrate	Open the detector and if the water surface is not like a mirror finish, adjust the flowrate.
	2) Shift of level adjustment for the measuring cell water surface	Check the level adjustment
	3) Turbidimeter not securely fixed	Confirm the tightness of the anchor bolts or the like .
	4) Large vibrations in surroundings	Change the signal averaging coefficient greatly. If the vibrations are violent, change the installation location.
	5) The reading may fiuctuate due to suspended substances in the sample water.	Greatly change the signal averaging coefficient.
c) Abrupt change in turbidity reading	1) Poor contact in wiring between the converter and detector	Re-tighten the connection terminal screws of the converter and detector.
	2) Influence from air bubbles	Greatly change the signal averaging coefficient. Excute bubble retardant function.
d) No change in analog output	1) Check the range setting and range operation mode.	Auto-range setting (on / off) Remote range setting (on / off) Local range setting (1 / 2 / 3) Upper and lower range limit setpoints
e) Turbidity value drift	1) Contamination of the measuring cell	Clean the measuring cell. For the model with automatic cleaning, shorten the cleaning interval.
	2) If automatic calibration is excuted, a dirty zero filter	Clean the filter element or for use over a prolonged period, replace it with a new one.
	3) Dim light-receiving lens	Adjust the temperature so that the difference between the measuring-water temperature and the ambient temperature is within the predetermined value (30°C). If the lens is dirty, clean it.
f) No converter display	1) Blown converter fuse	Replace it with the attached fuse required.
g) The " MEAS " lamp flashes.	1) An upper or lower limit alarm is detected.	Select FUNCTION " 8 " and/or FUNCTION " 9 " in the < PROGRAM1 > mode and change the setpoint(s), or select FUNCTION " 9. " in the < PROGRAM2 > mode and reset the function. The lamp stops flashing.

T080201.EPS

9. Spare Parts

Life limited parts are used in this system. Recommended period to replace the part is shown in the list. The replacing period shown in the list indicate a recommended period to perform preventive maintenance. This does not mean that the part is assured for an accidental failure during the period. The recommended period to replace the part is only for reference purposes and it depends on the operating conditions. The recommended period to replace the part may be revised according to the actual information from operating sites.

Spare Parts

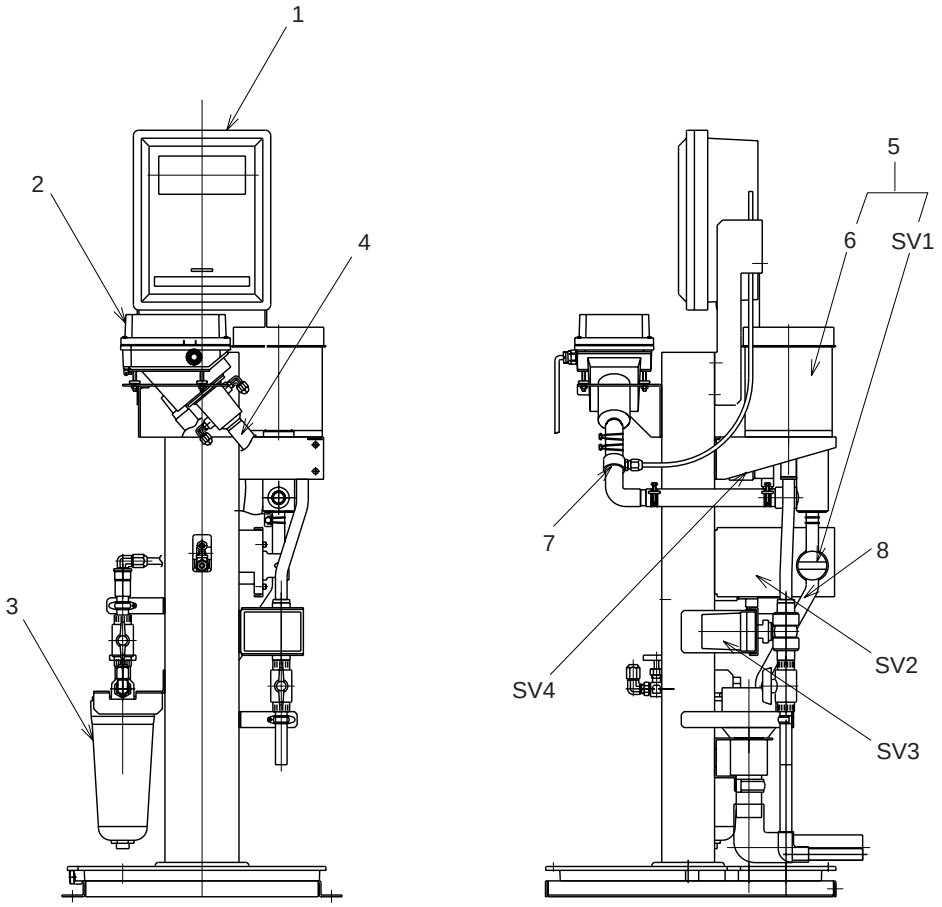
Name	Part No.	Recommend (*1)
Change Lamp	K9412AK	1 time / Half a year (*2)
1 micron Filter	K9008ZD	1 time / year
Fuse (1A)	A1109EF	1 time / year
Fuse (3A)	A1094EF	1 time / year
Soft PVC Tube 2m (ø33 Xø25 Black)	K9411ZF	1 time / year

T0901.EPS

(*1) Recommended replace period depends on application condition.
(*2) Please change soon when lamp disconnection (Err12) or lamp life error (Err25) is appeared.

Customer Maintenance Parts List

TB450G
Surface Scattered Type Turbidity Meter



Item	Part No.	Qty	Description
1	-	1	Converter (see page 2)
2	K9412AA	1	Detector (see page 3)
3	K9411UA	1	Zero Filter (see page 4)
	K9725LW		Zero Filter
4	K9411GC		Head Tank without Pinch Valve
5	K9411JA	1	Tank Assembly with Pintch Valve (AC100,110V)
	K9411JB		Tank Assembly with Pinch Valve (AC 200,220V)
6	K9411JC	1	Head Tank
SV1	-	1	Valve
	K9411JG		(for 100,110 V AC)
	K9411JH		(for 200,220 V AC)
SV2	-	1	Solenoid Valve
	A1113MV		(for 100 V AC)
	A1114MV		(for 200 V AC)
	A1115MV		(for 110 V AC)
	A1116MV		(for 220 V AC)

Item	Part No.	Qty	Description
SV3	-	1	Motor Valve
	K9411VE		(for 100,110 V AC)
	K9411VF		(for 200,220 V AC)
SV4	-	1	Solenoid Valve
	A1113MV		(for 100 V AC)
	A1114MV		(for 200 V AC)
	A1115MV		(for 110 V AC)
	A1116MV		(for 220 V AC)

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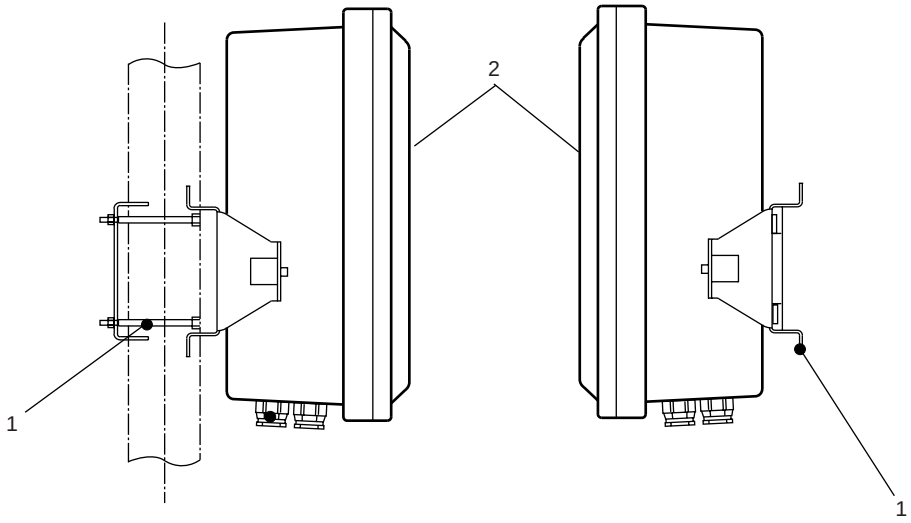
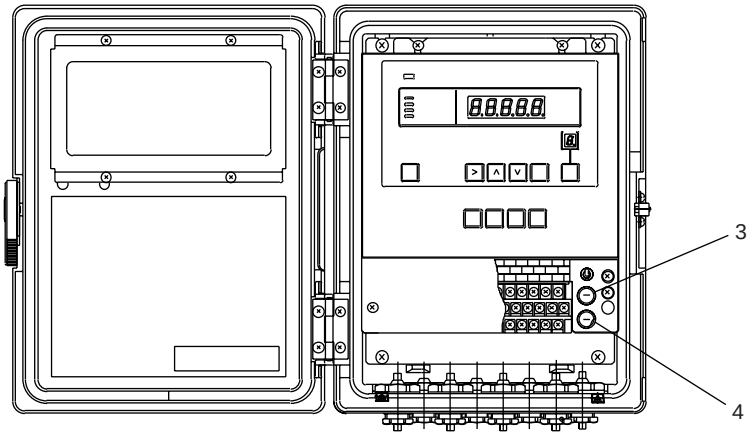
K9412E□ CONVERTER
G□





Item	Part No.	Qty	Description
1	-	1	Mounting hardware
	K9411ZG		(Option Code, in case of / P)
	K9411ZH		(Option Code, in case of / R)
2	-	1	Converter
	K9412EA		(for TB450G-L-4-1 and -3)
	K9412EB		(for TB450G-L-5-1 and -3)
	K9412EC		(for TB450G-L-4-6 and -7)
	K9412ED		(for TB450G-L-5-6 and -7)
	K9412GA		(for TB450G-H-4-1 and -3)
	K9412GB		(for TB450G-H-5-1 and -3)
	K9412GC		(for TB450G-H-4-6 and -7)
	K9412GD		(for TB450G-H-5-6 and -7)

Item	Part No.	Qty	Description
3	A1109EF	1	Fuse(1A)
4	A1094EF	1	Fuse(3A)

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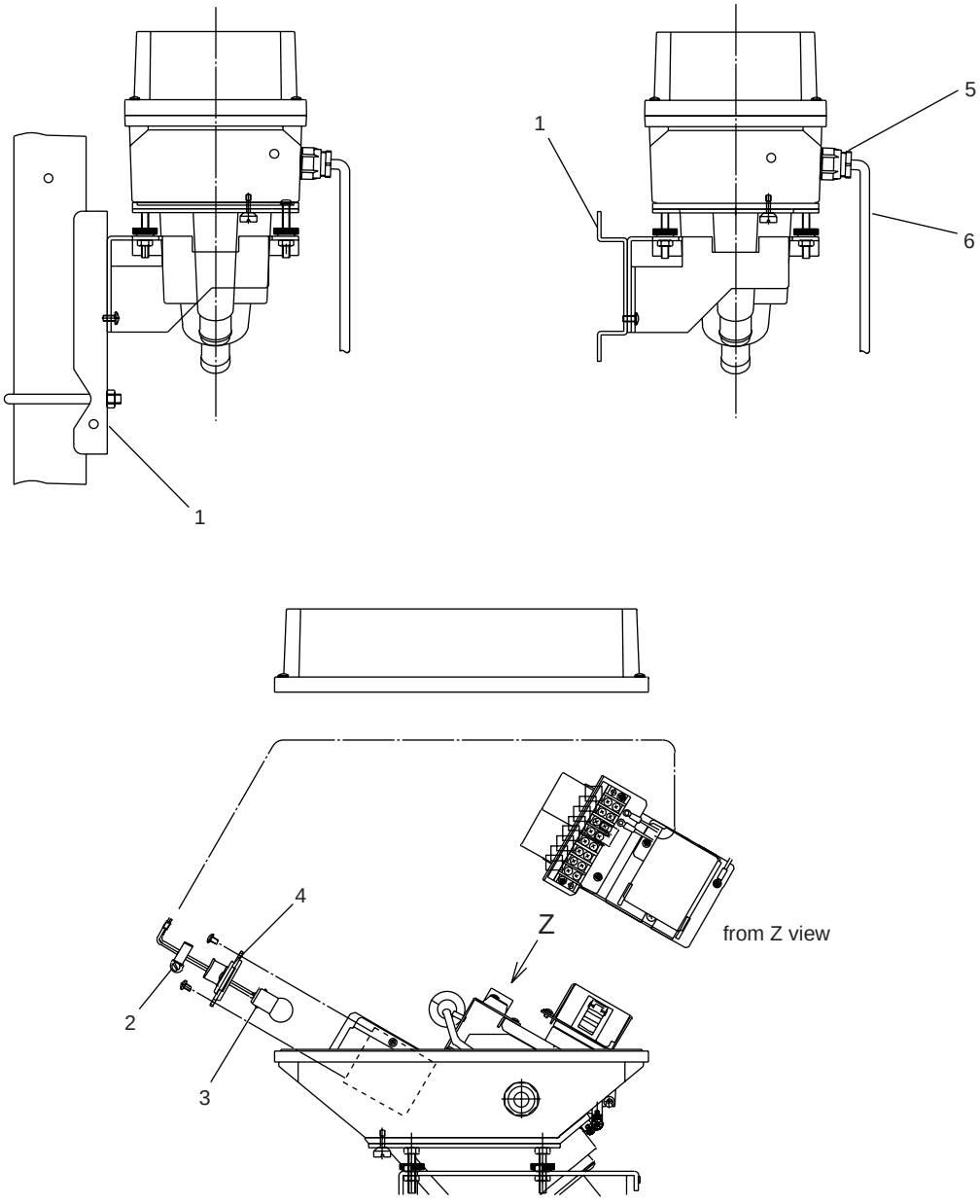
K9412AA DETECTOR



Item	Part No.	Qty	Description
1	-	1	Mounting hardware
	K9410DC		(Option Code, in case of / P)
	K9410DE		(Option Code, in case of / R)
2	L9813WE	1	Clamp
3	K9412AJ	1	Lamp Assembly
4	K9412BY	1	Holder
5	L9811CV	1	Cable Grand
6	K9410CQ	1	Cable Assembly

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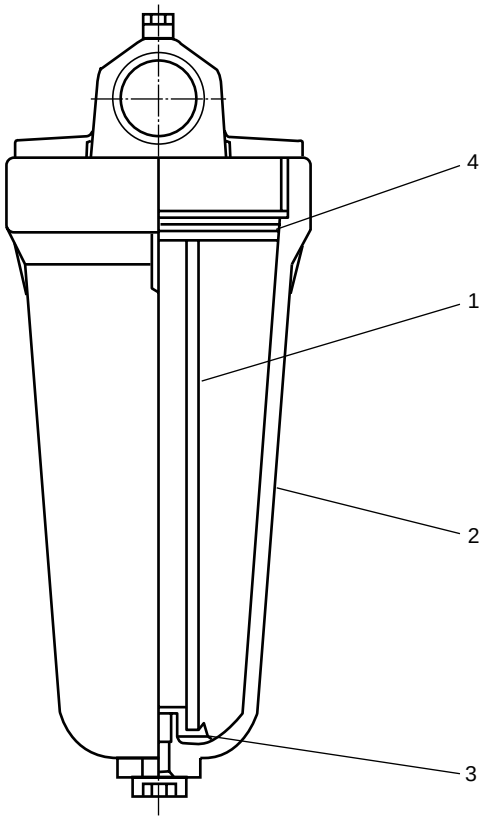
K9411UA ZERO FILTER (1 micron filter)



Item	Part No.	Qty	Description
1	K9008ZD	1	Filter Element (1 micron)
2	K9411UB	1	Case
3	K9008ZE	1	Plate
4	K9411UD	1	O-Ring

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Revision Record

Manual Title : Model 450G-H NTU-compliant Surface Scattered Type Turbidity Meter [High Renge Type]
Manual Number : IM 12E04A03-02E

Edition	Date	Remark (s)
1st	Apr. 2000	Newly published

User's Manual

Model TB450G-H
NTU-compliant Surface Scattered Type Turbidity Meter [High Range Type]

Supplement

Thank you for selecting Model TB450G-H NTU-compliant Surface Scattered Type Turbidity Meter [High Range Type]. The Instruction Manual IM 12E04A03-02E 1st edition supplied with this product has been amended as follows, please make a note in your copy.

-Page 2-7 P/N change of Fuze (3A) for spare parts.
-Page 9-1 P/N change of Fuze (3A) for spare parts.
CMPL 12E04A03-02E has been revised to 4th edition (some of P/N changed).

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IM 12E04A03-02E
1st Edition

2.5 Spare Parts

Name	Part No.	Recommend (*1)
Lamp	K9412AK	1 time / half a year (*2)
1 micron Filter	K9008ZD	1 time / year
Fuse (1A)	A1109EF	1 time / year
Fuse (3A)	A1113EF	1 time / year
Soft PVC Tube 2m (ϕ33 Xϕ25 Black)	K9411ZF	1 time / year

(*1) Recommended replace period depends on application condition.
(*2) Please change soon when lamp disconnection (Err12) or lamp life error (Err25) is appeared.

T25001.EPS

2.6 Sampling Parts

Name	Part No.
Pinch Valve for Drain water (100, 110V AC)	K9411JG
Pinch Valve for Drain water (200, 220V AC)	K9411JH
Solenoid Valve for Cleaning water or Zero water (100V AC)	A1113MV
Solenoid Valve for Cleaning water or Zero water (110V AC)	A1115MV
Solenoid Valve for Cleaning water or Zero water (200V AC)	A1114MV
Solenoid Valve for Cleaning water or Zero water (220V AC)	A1116MV
Motor Operated Valve for Sampling water (100, 110V AC)	K9411VE
Motor Operated Valve for Sampling water (200, 220V AC)	K9411VF
Head Tank (With Manual Valve)	K9411GC
Head Tank (With Pinch Valve 100, 110V AC)	K9411JA
Head Tank(With Pinch Valve 200, 220V AC)	K9411JB
Mounting Bracket for Head Tank	K9411BB

T26001.EPS

9. Spare Parts

Life limited parts are used in this system. Recommended period to replace the part is shown in the list. The replacing period shown in the list indicate a recommended period to perform preventive maintenance. This does not mean that the part is assured for an accidental failure during the period. The recommended period to replace the part is only for reference purposes and it depends on the operating conditions. The recommended period to replace the part may be revised according to the actual information from operating sites.

Spare Parts

Name	Part No.	Recommend (*1)
Lamp	K9412AK	1 time / Half a year (*2)
1 micron Filter	K9008ZD	1 time / year
Fuse (1A)	A1109EF	1 time / year
Fuse (3A)	A1113EF	1 time / year
Soft PVC Tube 2m (ϕ33 Xϕ25 Black)	K9411ZF	1 time / year

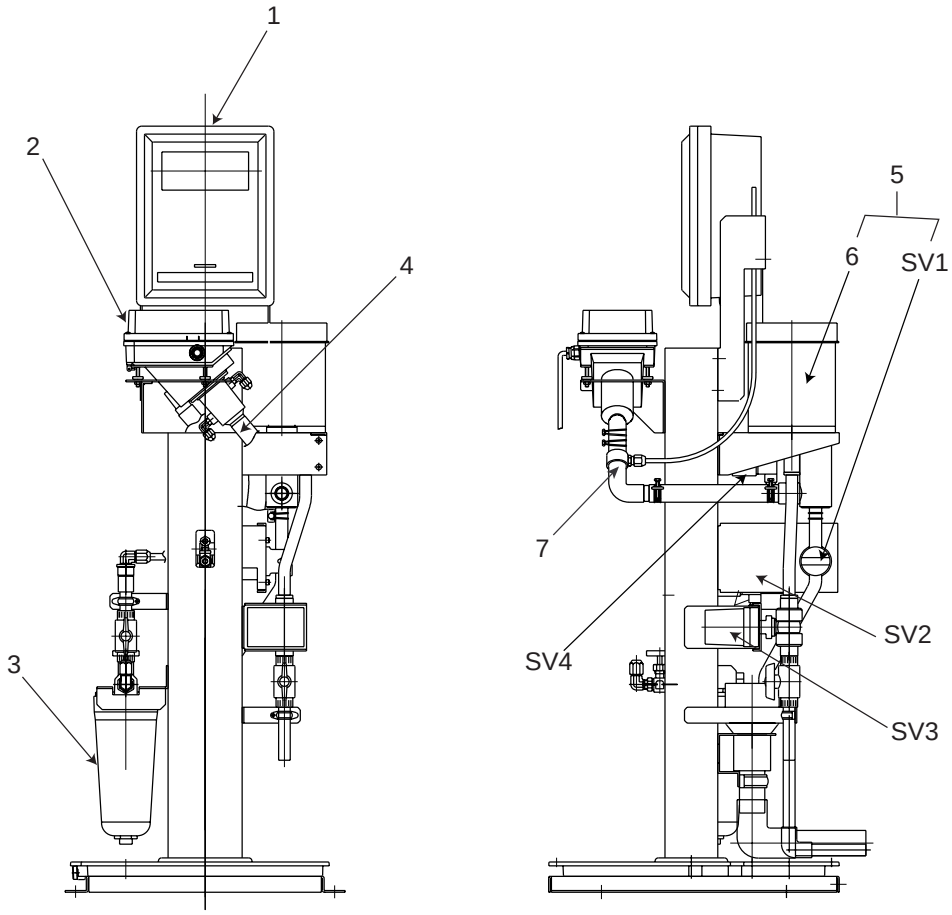
T0901.EPS

(*1) Recommended replace period depends on application condition.

(*2) Please change soon when lamp disconnection (Err12) or lamp life error (Err25) is appeared.

Customer Maintenance Parts List

Model TB450G-H
NTU-compliant Surface Scattered Type Turbidity Meter
[High Range Type]



Item	Part No.	Qty	Description
1	——	1	Converter (see page 2)
2	——	1	Detector (see page 3)
3	K9411UA	1	Zero Filter (see page 4)
4	K9411GC		Head Tank without Pinch Valve
5	——	1	Tank Assembly with Pintch Valve
			(100,110V AC)
	——	1	Tank Assembly with Pinch Valve
			(200,220V AC)
6	K9411JC	1	Head Tank
SV1	-	1	Valve
	K9411JG		(for 100,110 V AC)
	K9411JH		(for 200,220 V AC)
SV2	-	1	Solenoid Valve
	A1113MV		(for 100 V AC)
	A1114MV		(for 200 V AC)
	A1115MV		(for 110 V AC)
	A1116MV		(for 220 V AC)

Item	Part No.	Qty	Description
SV3	-	1	Motor Valve
	K9411DP		(for 100,110 V AC, Manufactured before Feb. 2009)
	K9411DT		(for 100,110 V AC, Manufactured after Feb. 2009)
	K9411DQ		(for 200,220 V AC, Manufactured before Feb. 2009)
	K9411DU		(for 200,220 V AC, Manufactured after Feb. 2009)
SV4	-	1	Solenoid Valve
	A1113MV		(for 100 V AC)
	A1114MV		(for 200 V AC)
	A1115MV		(for 110 V AC)
	A1116MV		(for 220 V AC)

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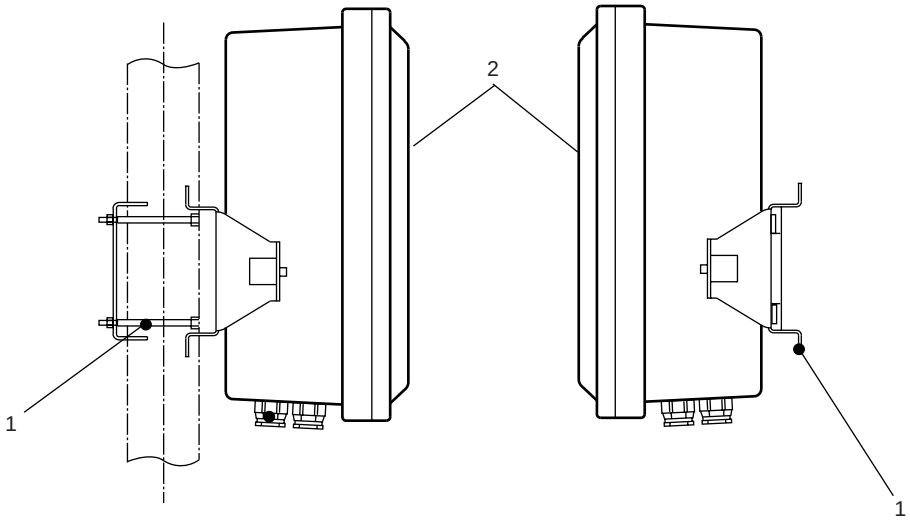
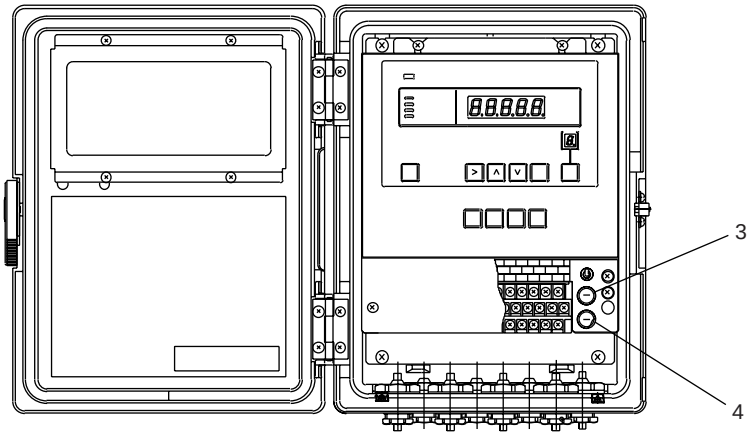
K9412E□ CONVERTER
G□





Item	Part No.	Qty	Description
1	——	1	Mounting hardware
	K9411ZG		(Option Code, in case of / P)
	K9411ZH		(Option Code, in case of / R)
2	——	1	Converter
	——		(for TB450G-L-4-1 and -3)
	——		(for TB450G-L-5-1 and -3)
	——		(for TB450G-L-4-6 and -7)
	——		(for TB450G-L-5-6 and -7)
	——		(for TB450G-H-4-1 and -3)
	——		(for TB450G-H-5-1 and -3)
	——		(for TB450G-H-4-6 and -7)
	——		(for TB450G-H-5-6 and -7)

Item	Part No.	Qty	Description
3	A1109EF	1	Fuse (1A)
4	A1113EF	1	Fuse (3A)

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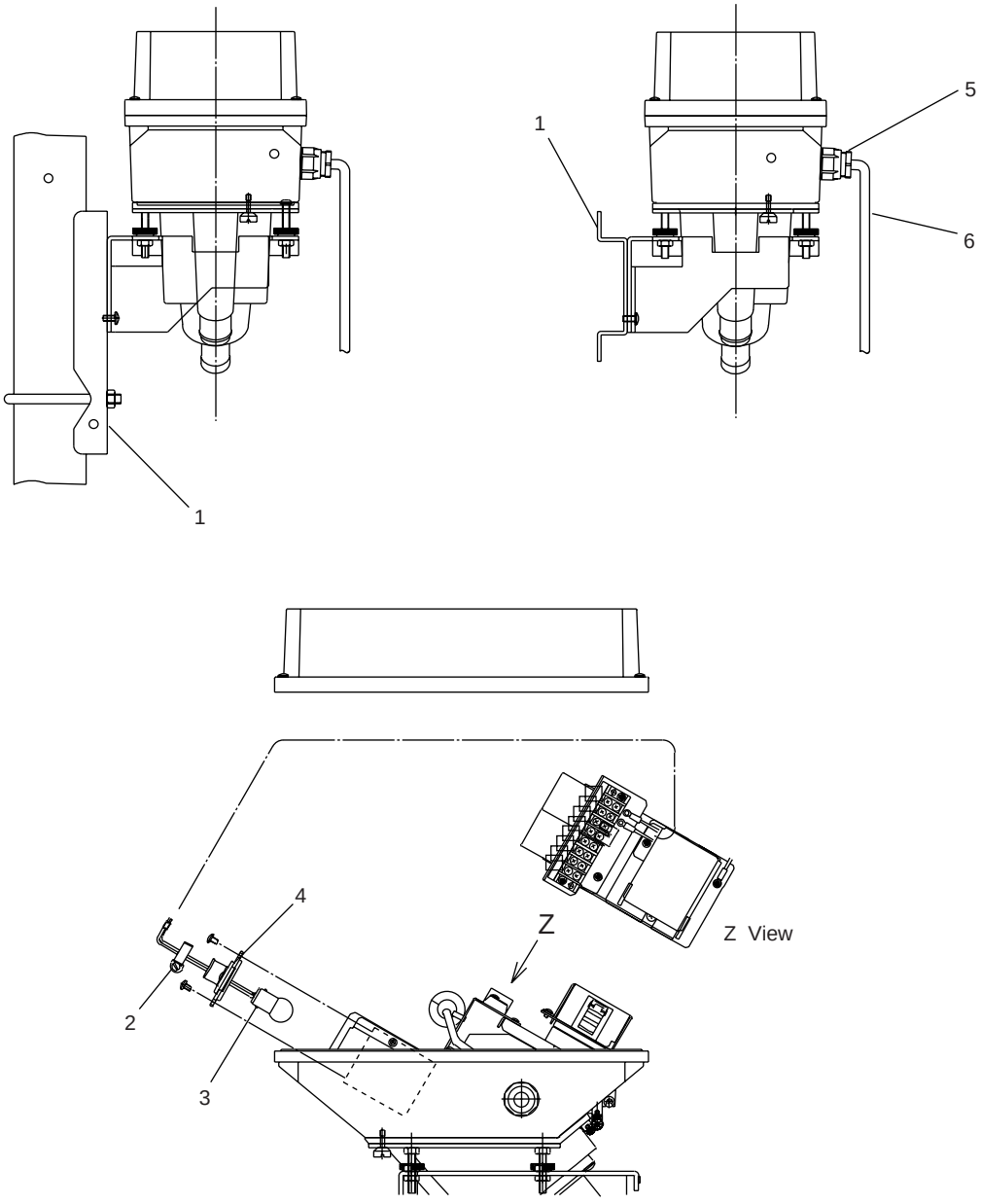
K9412AA DETECTOR



Item	Part No.	Qty	Description
1	——	1	Mounting hardware
	K9410DC		(Option Code, in case of / P)
	——		(Option Code, in case of / R)
2	L9813WE	1	Clamp
3	K9412AK	1	Lamp Assembly
4	K9412BY	1	Holder
5	L9811CV	1	Cable Gland
6	——	1	Cable Assembly

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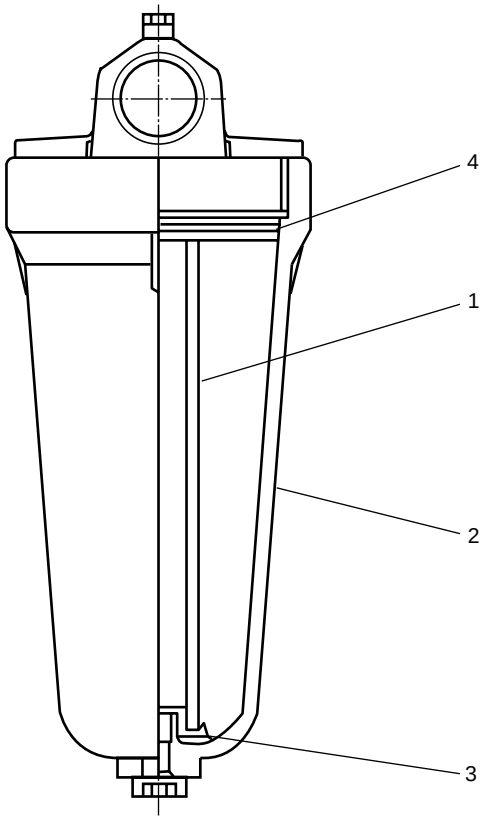
K9411UA ZERO FILTER (1 micron filter)



Item	Part No.	Qty	Description
1	K9008ZD	1	Filter Element (1 micron)
2	K9411UB	1	Case
3	K9008ZE	1	Plate
4	K9411UD	1	O-Ring

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